Maine Forestry Best Management Practices Use and Effectiveness 2005

Department of Conservation
Maine Forest Service
22 State House Station
Augusta, Maine 04333

Forest Policy and Management Division

November 2006

Helping you make informed decisions about Maine's forests
www.maineforestservice.org

Printed under Appropriation 010 04A 5100 512

Executive Summary

Control of water and sediment before, during, and after timber harvests is accomplished most efficiently and effectively by applying underlying principles of *Best Management Practices* (BMPs). While best management *practices* such as water bars, diversion ditches, and broad based dips, control water flow by slowing it down and spreading it out, application of these practices based upon *principles* such as pre-harvest planning, anticipating site conditions, and minimizing and stabilizing exposed soil, achieves the greatest protection of water resources in forested settings.[1]

This report presents findings from analysis of nine months of data collected between April 2005 and December 2005. The data tests for the first time a regional method based upon BMP principles, "Best Management Practices Implementation Monitoring Protocol," a project of the Northeastern Area Association of State Foresters' Water Resources Committee.

MFS has conducted random, statewide monitoring of BMPs on timber harvesting operations since March 2000. The objective of this ongoing effort is to assess the use and effectiveness of BMPs in Maine. MFS uses BMP monitoring to seek continual improvement of monitoring methods, identify trends for targeting technical assistance, and focus educational outreach efforts to loggers, foresters and landowners. As BMPs are voluntary measures to protect water quality, BMP monitoring is not used to assess compliance with or enforcement of laws and rules.

MFS continues this monitoring effort as a part of regular field activities and expects to generate subsequent reports. Improved monitoring methods make it difficult to compare specific year to year data. However evaluation of BMP use and effectiveness has remained constant and continues to show improvement. BMPs were used appropriately at 41% of the monitored harvests in 2000. In 2005, 79% of the stream crossings and 92% at the approaches to the crossing had appropriate use of BMPs. Conversely, BMPs were not applied at 25% harvest in 2000. 2005 data shows BMPs were not applied at only 4% of the crossings and 6% of the approaches, an approximate five-fold improvement over five years.

For this reporting period, key findings regarding the use and effectiveness of BMPs are:

- **When applied appropriately, BMPs avoided soil movement into waterbodies at 92% of the approaches to stream crossing structures and 79% of the crossing structures themselves.**
- **Timber harvests that extended into riparian areas retained 80% average forest canopy crown closure.**
- **At sites where BMP principles and practices were not applied appropriately in sediment reached the water at 25% of the approaches and 44% of the stream crossings.**

[1] Ryder, R., Edwards, P. J. 2005. Development of a Repeatable Protocol for Performance-Based Monitoring of Forestry Best Management Practices: U.S. Department of Agriculture, Forest Service, General Technical Report NE-335, 15 pp.

- **Forty-five percent of harvest sites with water present in the immediate harvest area did not have stream crossings.** Harvest planning that avoids crossing waterbodies is a valid BMP.

This study also developed additional information on the context in which BMPs are applied:

- **The predominant permanent crossing structure type is single culverts, of which 67% had *scouring* within 100' of the outlet.** Scouring is indicative of an undersized structure that restricts normal stream channel flow, often inhibiting aquatic organism passage. This data supports MFS's current educational and technical assistance focus on permanent innovative crossing structures and the introduction of temporary crossing structure options.
- **Harvests with contractual assignment of BMP responsibilities to either a forester or logger had significantly less amounts of sediment reach the waterbody.** Defining objectives and assigning responsibilities for BMPs are key *principles* for achieving desired water resource protection outcomes.

Of Special consideration when reviewing facts and figures within this report:

2005 Recorded as the "Wettest Year on Record" for Maine[2].

Caribou, ME	Wettest year on record with 54.21"
Concord, NH	Wettest year on record with 57.17"
Portland, ME	Wettest year on record with 66.45"
MAINE	State record for wettest year on record set at Acadia with 76.13"

Precipitation events and amounts during 2005 presented extraordinary operational challenges to forest practitioners in Maine. Many loggers and foresters experienced significant reductions in annual output as they curtailed operations in order to reduce environmental risks associated with saturated soils and crossing streams at or above *bankfull* levels.

[2] National Oceanic and Atmospheric Administration , Data Climate Center: year2005US-climate-assessment

Introduction and Background

The 118th Maine Legislature directed the Maine Forest Service (MFS) to evaluate the progress made by timber harvesting operations in implementing forestry Best Management Practices (BMPs) to protect water quality (PL 1997, Chapter 648). This legislative directive responded in part to the findings of the Briggs study of 1996[3], a joint effort by MFS, university researchers, and the Forestry Advisory Team (FORAT). FORAT is a broad-based advisory group of stakeholders whose mission is to advise MFS and the Department of Environmental Protection on water quality issues related to forest management.

The Briggs study reported on BMP use and effectiveness by examining recommended BMPs in detail on 120 harvest sites. The study concluded that applicable BMPs work well when implemented, but that use of individual BMPs varied from very low to very high. There was broad recognition of the need to provide regular, statewide information on trends in BMP use and effectiveness. Such information would help MFS to focus educational efforts for foresters, loggers, and landowners in BMP use.

- With FORAT's assistance, MFS developed a monitoring protocol to conduct regular, statewide monitoring of BMP use and effectiveness on timber harvesting operations.
- USDA Forest Service Northeastern Watershed Team and USEPA supported this effort by funding development of a regional BMP monitoring protocol within the 20 states in the USFS Northeastern area and Virginia.
- An extensive test of the protocol began in five northeastern states in June 2004 to: 1) ensure the protocol can be used in a variety of field settings; 2) ensure scientific credibility; and 3) improve protocol questions to better address local and regional BMP guidelines.
- A Regional BMP Monitoring Protocol for timber harvesting has now been tested in 11 states in the northeastern United States.

In Maine, harvest sites were selected randomly in ten districts statewide, based on Forest Operations Notifications submitted to MFS. MFS requested landowner permission to conduct the field work, which did not assess compliance with state statutes, regulations, or local ordinances but rather evaluated use and effectiveness of BMPs.[4]

Monitoring of randomly selected field harvest sites by MFS Field Foresters and Forest Rangers was conducted from April to December 2005. This report presents the first compilation of data using this regional protocol. Data collection by MFS personnel focuses on areas of recent harvest activity and the presence of surface water, thereby capturing worst case scenario results.

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[3] Briggs, R., Kimball, A., Cormier, J. 1996. Assessing compliance with BMPs on Harvested Harvest sites in Maine: Final Report. University of Maine, Cooperative Forestry Research Unit Research Bulletin 11. 35 pp.

[4] Readers interested in detailed information on the methodology are encouraged to contact MFS.

Comparison of BMP Use from Previous Reporting Periods

Data collected from MFS continues to indicate increased use and effectiveness of BMP implementation. Evaluation methodology has improved with use the Regional Protocol with separate evaluations for the crossing and the approaches to the waterbody. Previous reporting periods did not specify potential sources of sediment.

Reporting Period	2000 - 2001	2001-2003	2005
Number of harvest with waterbodies (n)	181	288	102
BMPs used appropriately	41%	52%	79% at crossings 92% at approaches
BMPs not applied	25%	8%	4% at crossings 6% at approaches

Acknowledgements

Landowner permission was obtained prior to conducting BMP surveys. Often landowners, loggers, and foresters requested they accompany MFS field staff during site evaluations. With over 90% positive response to MFS survey requests, it is evident that Maine landowners are sincere about conducting timber harvesting practices which protect and enhance water quality. MFS is delighted with the high rate of landowner participation and their engagement with BMP monitoring, without which this comprehensive report would not be possible.

MFS also extends appreciation to the Massachusetts Department of Conservation and Recreation, University New Hampshire Cooperative Extension Service, and New York City's Watershed Agricultural Council who acted as quality control teams assuring consistent application of the monitoring protocol by MFS field staff.

Special thanks to **Kristina A. Ferrare and Paul K. Barten, University of Massachusetts Amherst Department of Natural Resources Conservation and David Welsch USDA Forest Service Northeast Area Watershed Specialist** for development of the standardized reporting system which greatly assisted in efficient final report development and timely public availability.

Absent significant changes in staffing levels or bureau priorities, MFS expects to continue BMP monitoring indefinitely and to report periodically on the most recent data utilizing the U.S. Forest Service - Northeastern Area, Best Management Practices (BMP) Protocol: Monitoring Implementation and Effectiveness for Protection of Water Resources.

Introduction to Standardized Reporting

The information presented in this Standard Data Summary was collected using the U.S. Forest Service - Northeastern Area, Best Management Practices (BMP) Protocol: Monitoring Implementation and Effectiveness for Protection of Water Resources.

The BMP Protocol provides an efficient, economical, standardized, and repeatable BMP monitoring process that is automated from data gathering through generation of a Standard Data Summary. It uses commonly available software and inexpensive field data recording devices. It is compatible with existing state BMP programs and available for use by forestry agencies, forest industry and green certification organizations.

Further information, manuals, software program and training in the protocol procedures and report generation can be obtained from Dave Welsch or Al Todd U.S. Forest Service, Northeastern Area - Watershed Team.

Standard Data Summary

The information in this Standard Data Summary was compiled from measurement of **102** sample units in the state of **Maine**.

The Standard Data Summary is a computer generated set of graphs and charts summarizing the sample unit data in a standardized format to facilitate comparison with data collected from other times and differing geographical areas.

Each sample unit contains the potential for approximately 200 observations and includes a number of observations of some types of data. Proportions presented in the charts and graphs in the standard data summaries are based on the total number of possibilities for a condition to occur. Null observations are included in the calculations to ensure that the proportions total 100%, and the frequency of problems is accurately reported.

The data collection procedure is described in the Best Management Practices (BMP) Protocol Field Guide: Monitoring Implementation and Effectiveness for Protection of Water Resources which includes the question set and instructions for making and recording the observations. Diagrams and definitions are also included.

Data Summary generation, quality control, risk analysis and statistical sample design information are described in the Best Management Practices (BMP) Protocol Desk Reference: Monitoring Implementation and Effectiveness for Protection of Water Resources.

Background

The Best Management Practices Protocol was a cooperative effort of the Northeastern Area State and Private Forestry (NA) and the Northeastern Area Association of State Foresters - Water Resources Committee (NAASF-WRC). The project has been funded by grants from the USDA Forest Service (NA) and the US Environmental Protection Agency (EPA).

The original concept and question sequence was developed by Roger Ryder and Tim Post of the Maine Forest Service in collaboration with Dave Welsch and Al Todd, USDA

Forest Service. Dave Welsch, NA Forester/Watershed Specialist, served as project coordinator through the development, testing, and implementation of the project.

The data summary and analysis phases of the project were developed by Kristina A. Ferrare and Paul K. Barten of the University of Massachusetts - Amherst, Watershed Exchange and Technology Partnership.

State forestry agencies from ME, NH, VT, MA, NY, WI, WV, MD, IN, DE, OH, PA, VA and the New York City Watershed Agricultural Council, Forestry Program as well as USDA Forest Service Northeastern Area and USDA Forest Service Northern Research Station personnel have collaborated in the development and testing of the BMP Protocol.

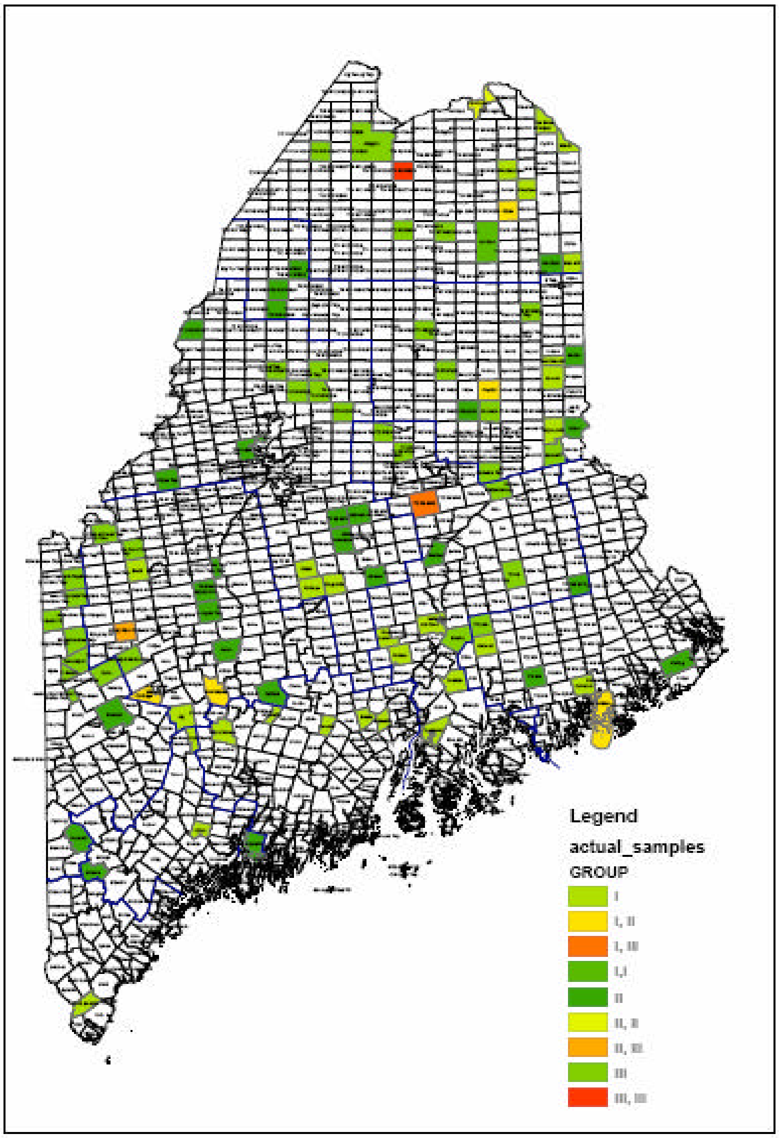
Standard Data Summary Contents

General Information Feature

This report presents the results of data gathered for the BMP Protocol project on new sample units for the state of **ME**.

- A total of **102** new sample units were sampled.

General Location Map of Sample Units from Randomly Selected Forest Operation Notifications.



Ownership Category

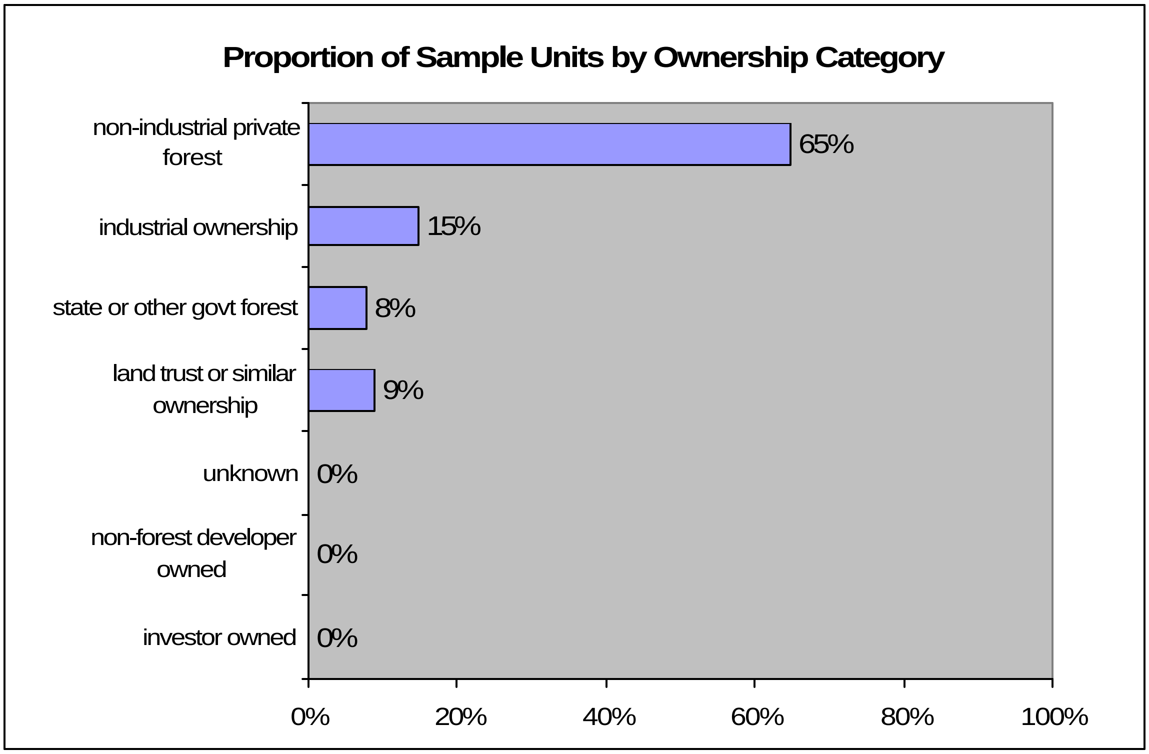


Figure 1 (n=102)

2005 data grouped together non-industrial private forest (NIPF) with investor owned ownership categories; therefore, 0% shows in the investor owned category. Regional protocol updates make the distinction and should be available for the 2007 monitoring season. NIPF is defined typically by smaller family forests or groups not directly associated with primary forest industries. The investor owned category will include corporate private entities such as institutional investors, logging companies, timberland land investment organizations, and land acquired on behalf of individuals yet managed by private companies.

In Maine, over 5.5 million acres of forest land has changed title over the past ten years. The shift from large industrial ownerships to various forms of investor ownerships has been the largest driver of this change. This change of ownership category represents approximately a 60 percent increase between 1995 and 2003[5]

[5] McWilliams, W.H. et al 2005. The Forest of Maine 2003: U.S. Department of Agriculture, Forest Service, Northeastern Research Station, Research Bulletin NE-164, 186 pp.

Acres Monitored

Total number of acres monitored: **9,068**

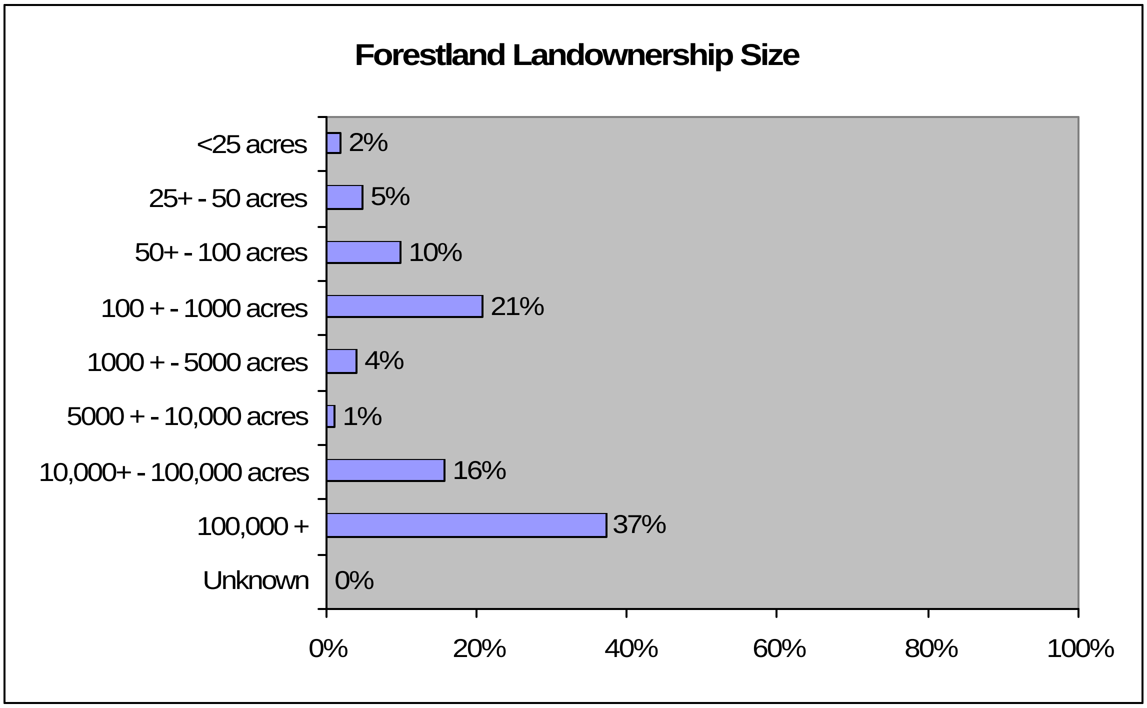


Figure 2 (n=102)

The total number of acres monitored equates to the area sum of all sample units where data was collected. One or two sample units where chosen at each harvest monitored. MFS personnel focused on recently harvested areas adjacent to surface water.

Sample units are delineated by cutting boundaries, ownership boundaries and by the crossing of natural perennial and intermittent streams and some ditches. The crossing and its approaches are investigated and the data recorded in the sample unit being entered as the water body is being crossed. The delineation of sample units and the features to be included within them are shown on the following illustration.

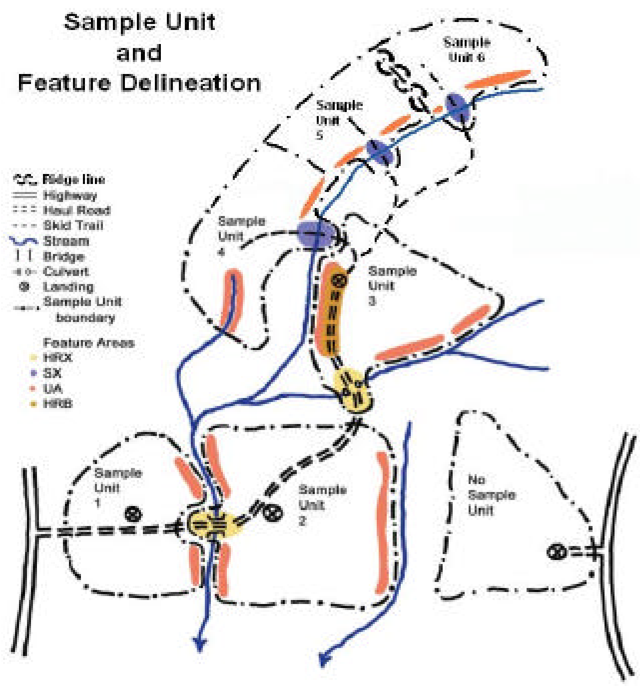
It may be helpful to think of a harvest as a house and sample unit as a room within the house. When you pass through a doorway you move from one room into another. Similarly, in the sample unit, the doorway and thresholds represent the approaches and water crossing. Walls within the room represent the property line, riparian zone, or edge of the harvest.

Identifying Discrete Sample Units

Eliminates averaging of conditions

Focus on areas of greatest potential water quality impact

Measure evidence



In order for a sample unit to exist, a riparian area or stream must be present on the harvest site. MFS personnel did not collect data if a sample unit was not present. This important distinction recognizes pre-harvest planning efforts by forest practitioners in avoiding stream crossings, a valid BMP. Forty-five percent of the sample units did not have water crossings even though water was present within the harvest area. MFS does not distinguish if avoiding a crossing positively or negatively impacted the forester practitioner's ability to complete the harvest.

***BMP Principle**: Pre-Harvest Planning*

Laying out the harvest on the ground can help identify sensitive areas, reduce skid trails, and avoid unnecessary stream crossings.

Harvest Systems Used

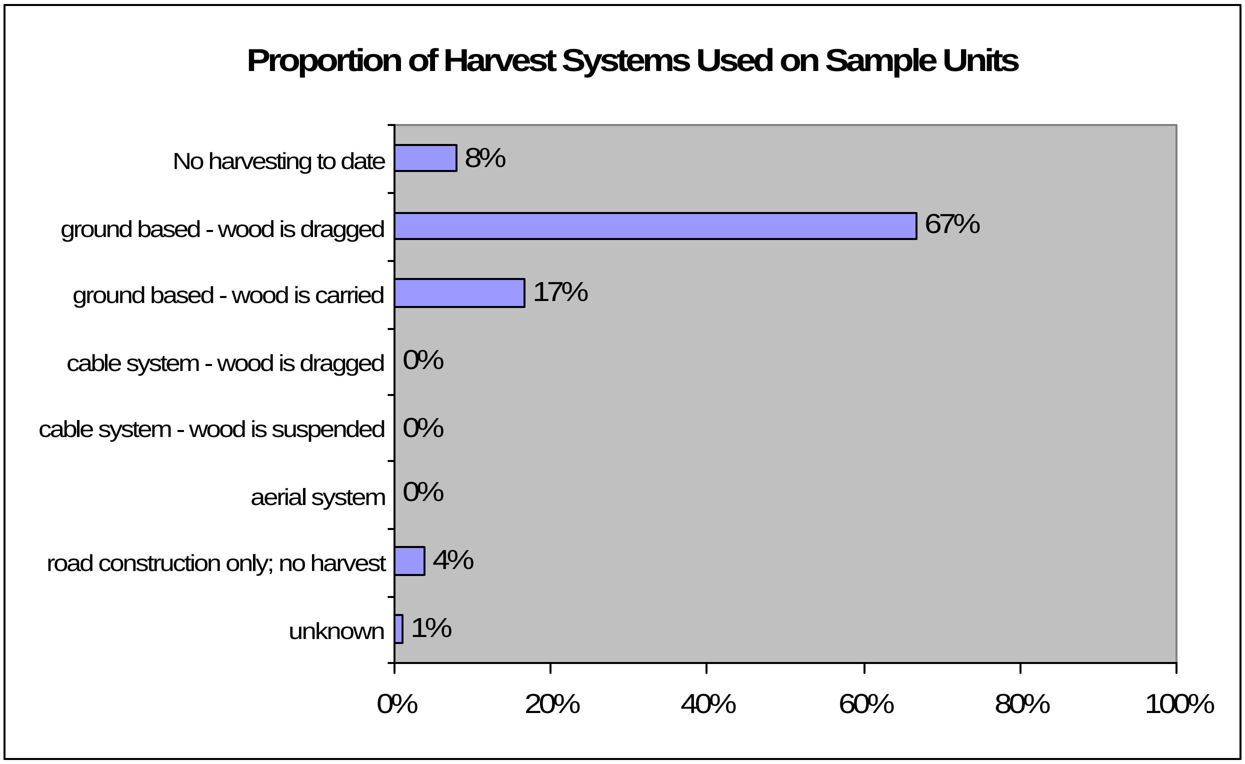


Figure 3 (n=102)

Ground based - dragged harvesting systems usually require use of cable or grapple skidders where trees are harvested individually or pre-bunched mechanically and dragged to the landing for further processing, sorting, or loading for off-site transport. Harvests that are primarily ground based dragged typically result in greater amounts of exposed soil. **Ground based - carried** harvesting systems generally result in less exposed soil hence reduced environmental risk. Trees are typically cut to length in the woods and then carried or “forwarded” to the landing for further processing, sorting, or loading for off-site transport.

Cable - dragged or suspended and aerial harvesting systems common in western mountain states are rare in Maine. Prolonged steep slopes and naturally occurring unstable soils generally do not occur in Maine to the same extent as out West.

BMP Implementation

- BMP Implementation is mandatory for **8%** of the sample units.

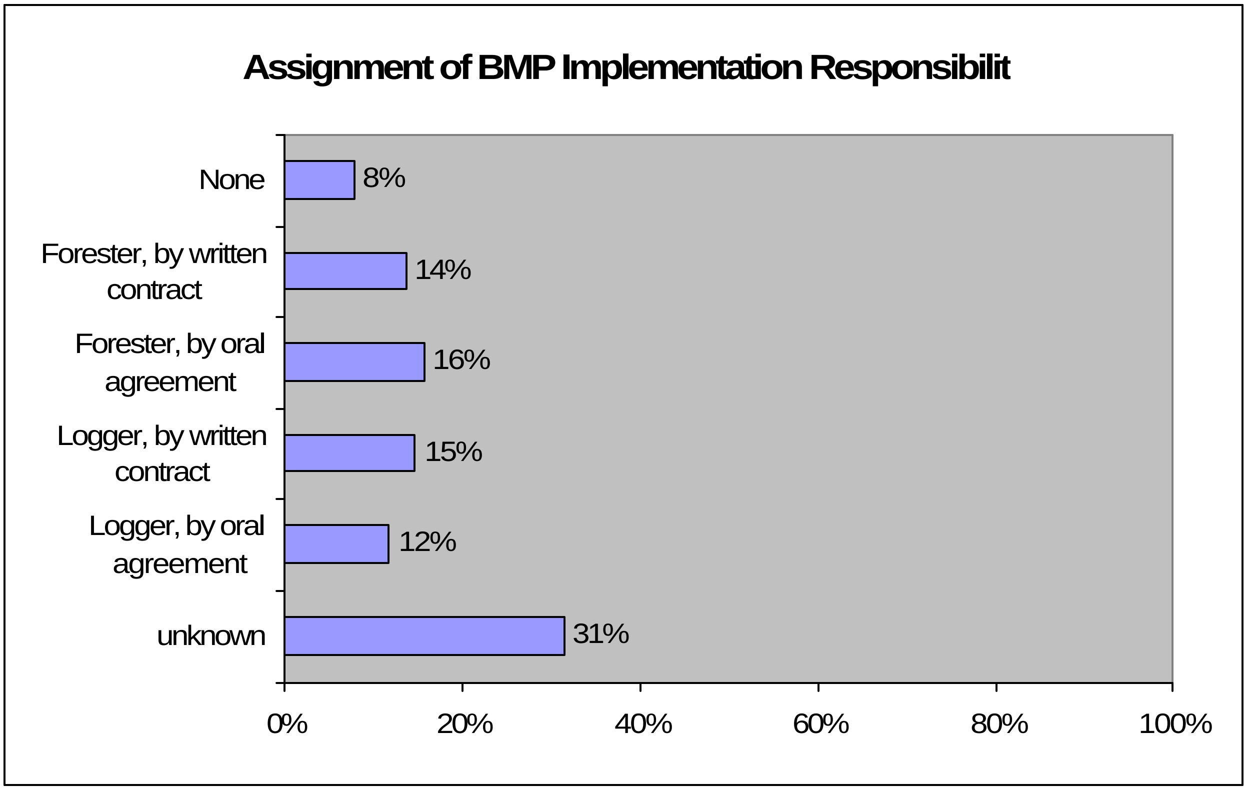


Figure 4 (n=102)

BMPs are voluntary in Maine. The 8% mandatory BMPs identified above may be resultant of additional contractual agreements between the landowner, logger, and forester or an enforcement action where remedial activities need to follow specific BMP practices in order to stabilize an erosion or sedimentation problem.

The Maine Forest Service recommends identifying who is responsible for BMP implementation within a written timber sale agreement that clearly explains landowner, logger, and forester expectations.

***BMP Principle**: Define objectives and responsibilities*

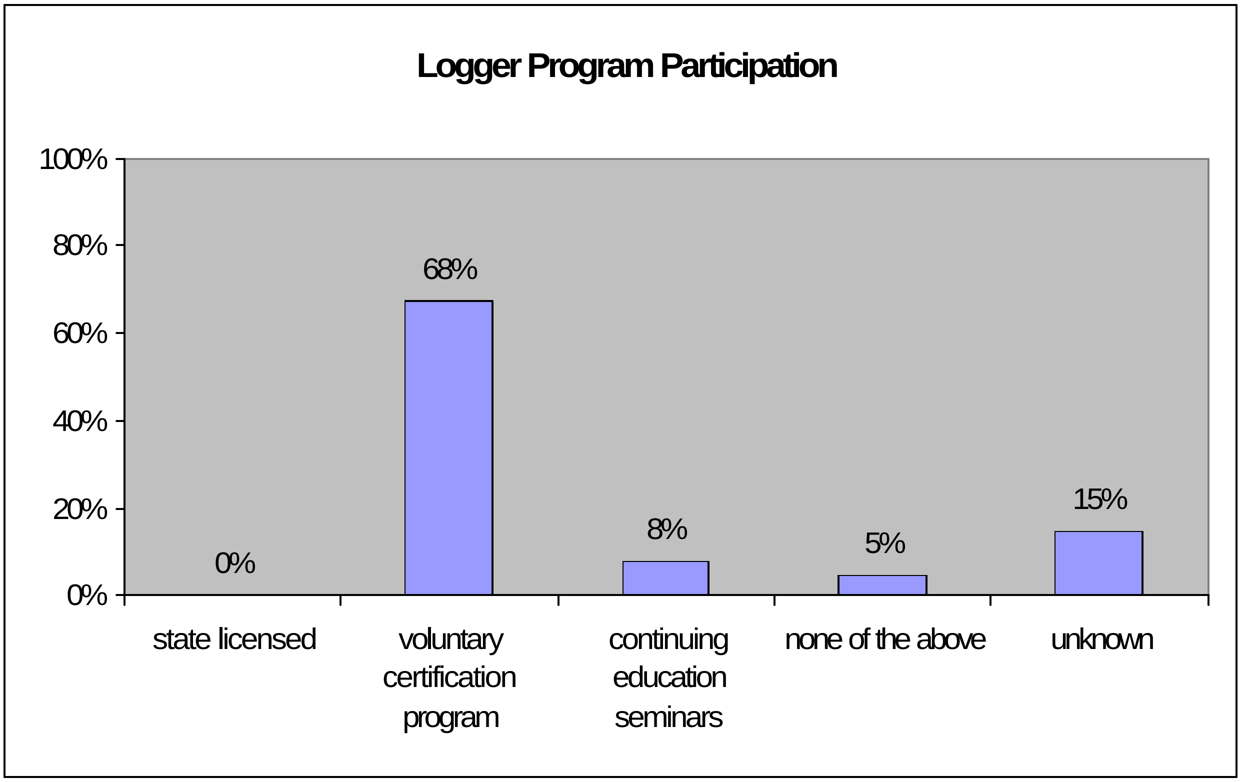


Figure 5 (n=102)

Discussion

Many loggers voluntarily participate in second and third party certification programs in Maine; Certified Logging Professional (CLP), Qualified Logging Professionals (QLP) and Maine's Master Logger. CLP with assistance from many partners has certified over 5000 loggers sine 1991. CLP along with other logger certification programs require continuing education credits and periodic field auditing on active timber harvests. Maine logger programs have significantly reduced logger worker compensation costs by promoting safety and accident prevention.[6]

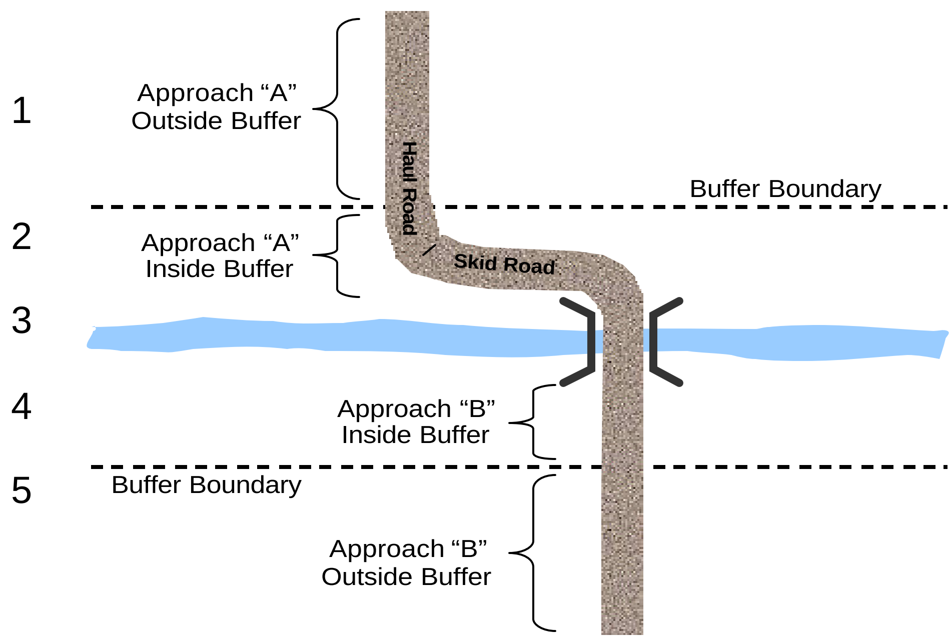
[6] Mike St. Peter, CLP Director, email and personal communication, June 2006: Certified Logging Professional program

Soil Movement, Sedimentation and Stabilization

There are **five** opportunities to observe the occurrence of soil movement, soil sedimentation, or stabilization for each sample unit. They are at Approach A outside the buffer, Approach A inside the buffer, the crossing structure, Approach B inside the buffer, and Approach B outside the buffer. **Proportions in this section are based on the total number of opportunities to make observations about soil conditions:**

For the **102** new sample units, there are **510** opportunities to observe soil conditions.

Illustration 2. Showing 5 opportunities to observe soil movement at any typical haul road or skid trail stream crossing



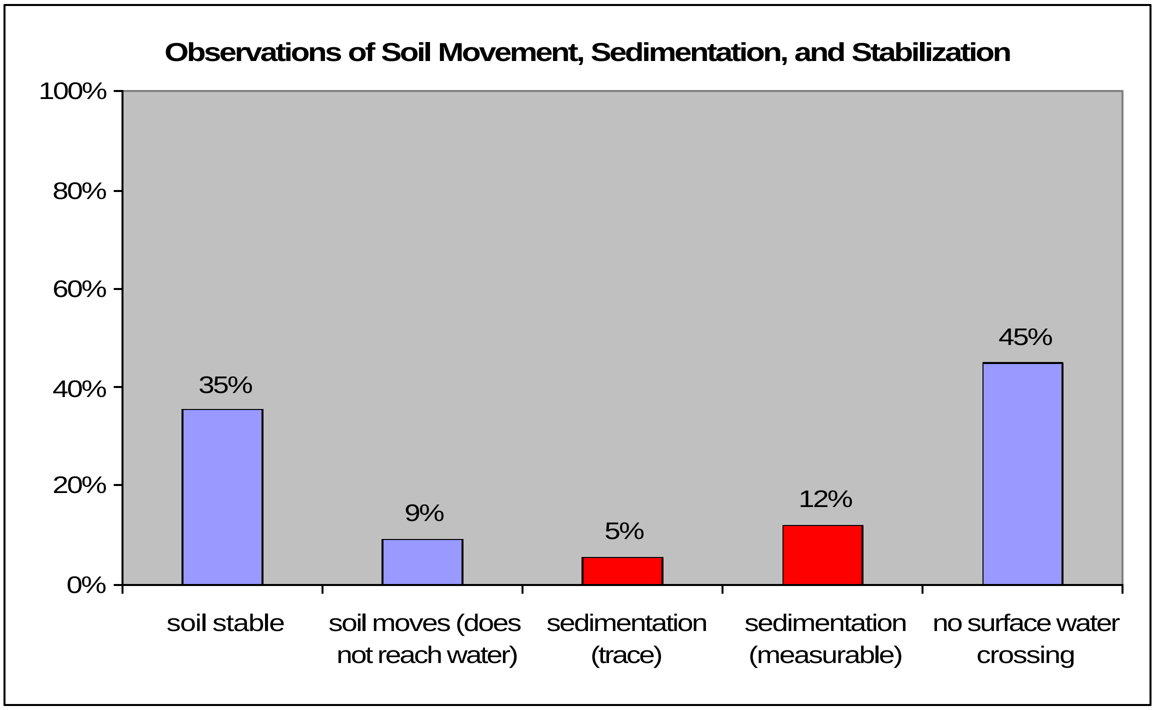


Figure 6 Observations of soil movement, sedimentation and stabilization as a proportion of total opportunities to observe soil conditions in the protocol **(n=510).**

Discussion

Of the 510 opportunities to observe soil conditions, 17% showed either trace or measurable amounts of sediment reached the waterbody. Excluding avoided stream crossings, 30% of sample units with crossings had either measurable or trace amounts of sediment reach the waterbody.

Sedimentation by Area of Origin

There are **90** observations of sediment reaching the surface water body or deposited within bankfull channel width of the water feature.

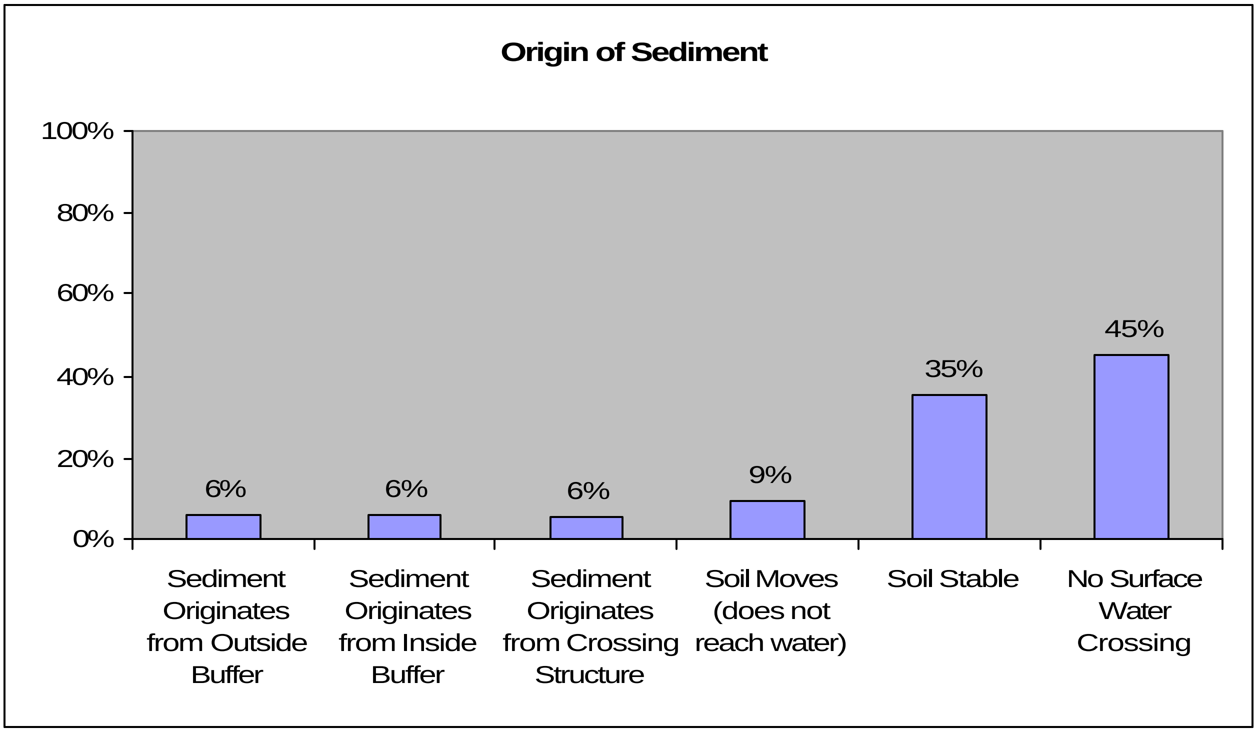


Figure 7 (n=510)

Trace and Measurable Sediment by Area of Origin

The following charts compare observations of trace amounts of sediment by area of origins to observations of measurable amounts of sediment by area of origin.

There are **28** observations of trace amounts of sediment reaching the surface water body or deposited within bankfull channel width of the water feature.

There are **62** observations of measurable amounts sediment reaching the surface water body or deposited within bankfull channel width of the water feature.

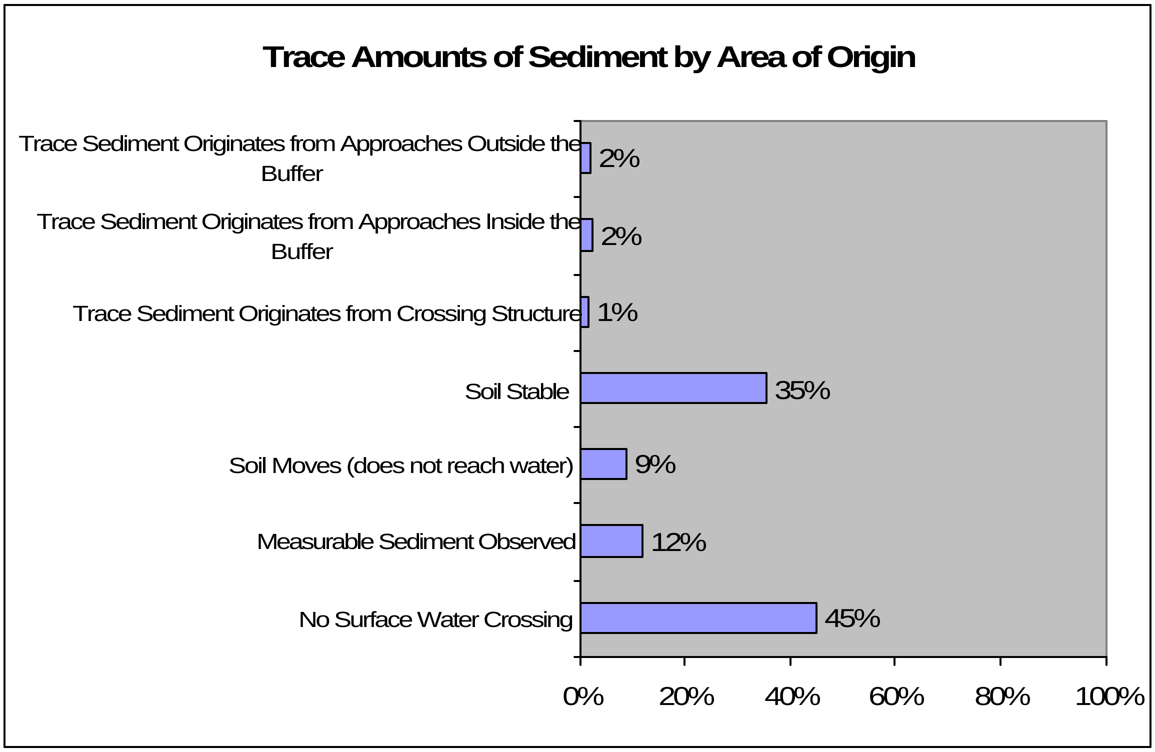


Figure 8 Proportions are based on the total number of opportunities to observe soil conditions **(n=510)**.

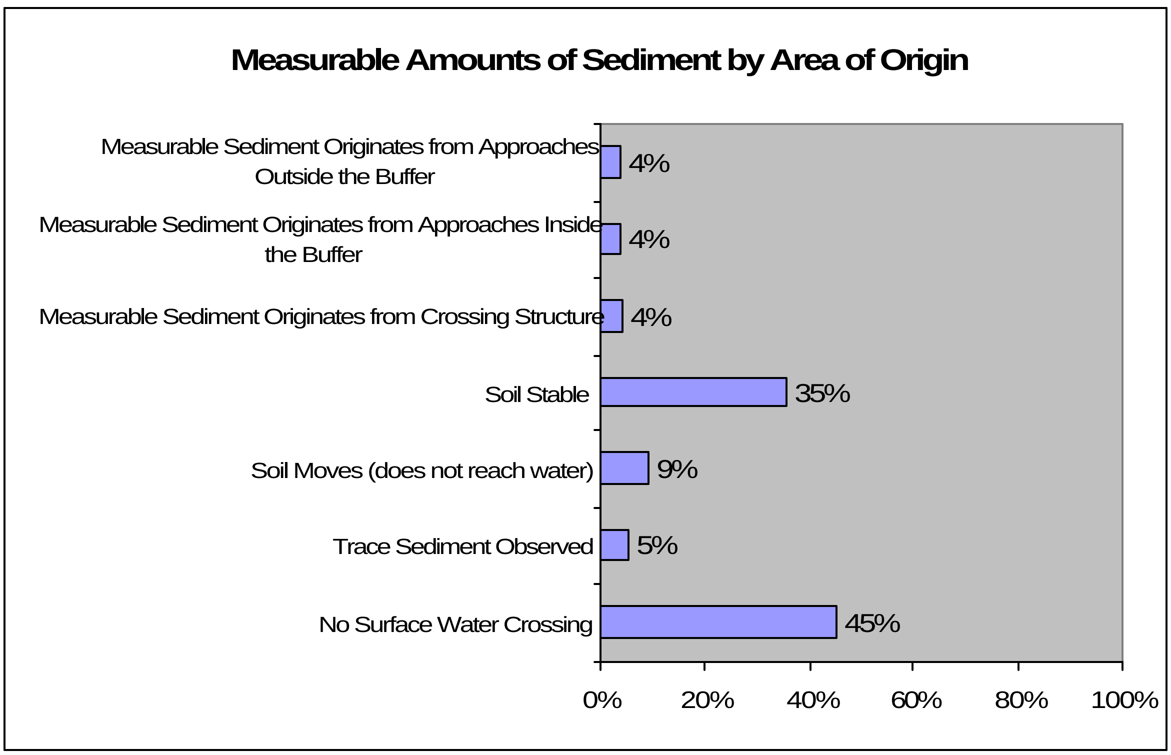
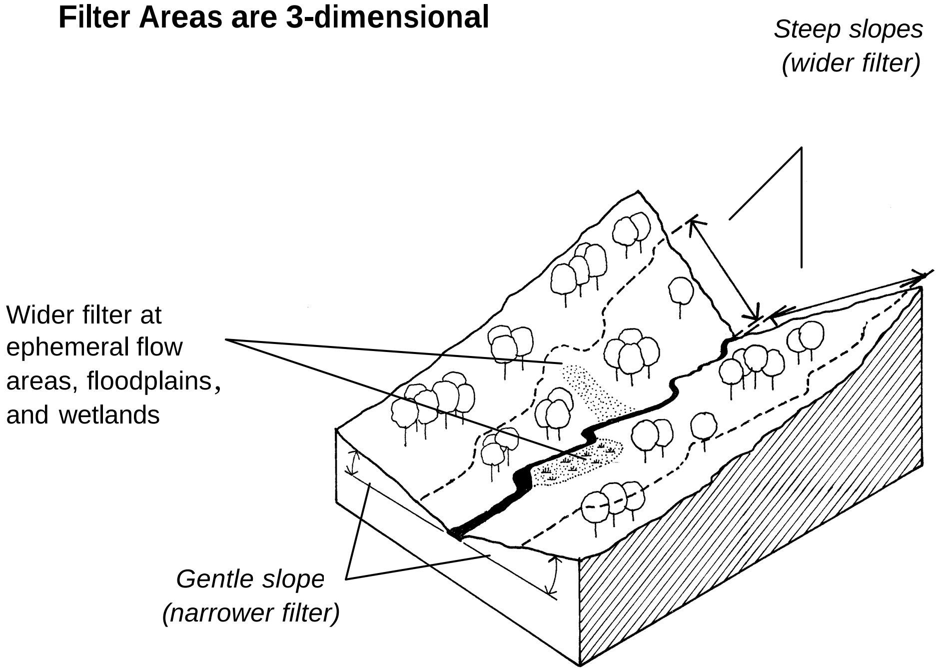


Figure 9 Proportions are based on the total number of opportunities to observe soil conditions **(n=510)**.

***BMP Principle**: Minimize and Stabilize Exposed Soil*

The amount of exposed soil is directly correlated to amount of water quality risk associated with timber harvesting. The Maine Forest Service recommends minimizing exposed mineral soil adjacent to water bodies and stabilizing immediately if it occurs. Follow recommended filter area widths in MFS's Best Management Practices for Forestry: Protecting Maine's Water Quality adjusting for percent slope and distance to waterbody.

Filter Areas are 3-dimensional



Approaches to Water Crossing

There are **four** opportunities to observe the occurrence of soil movement, soil sedimentation, or stabilization from the approaches to a surface water crossing. They are at Approach A outside the buffer, Approach A inside the buffer, Approach B inside the buffer, and Approach B outside the buffer. **Proportions are based on the total number of opportunities to make observations about soil conditions at the approaches.**

For the **102** new sample units, there are **408** opportunities to observe soil conditions.

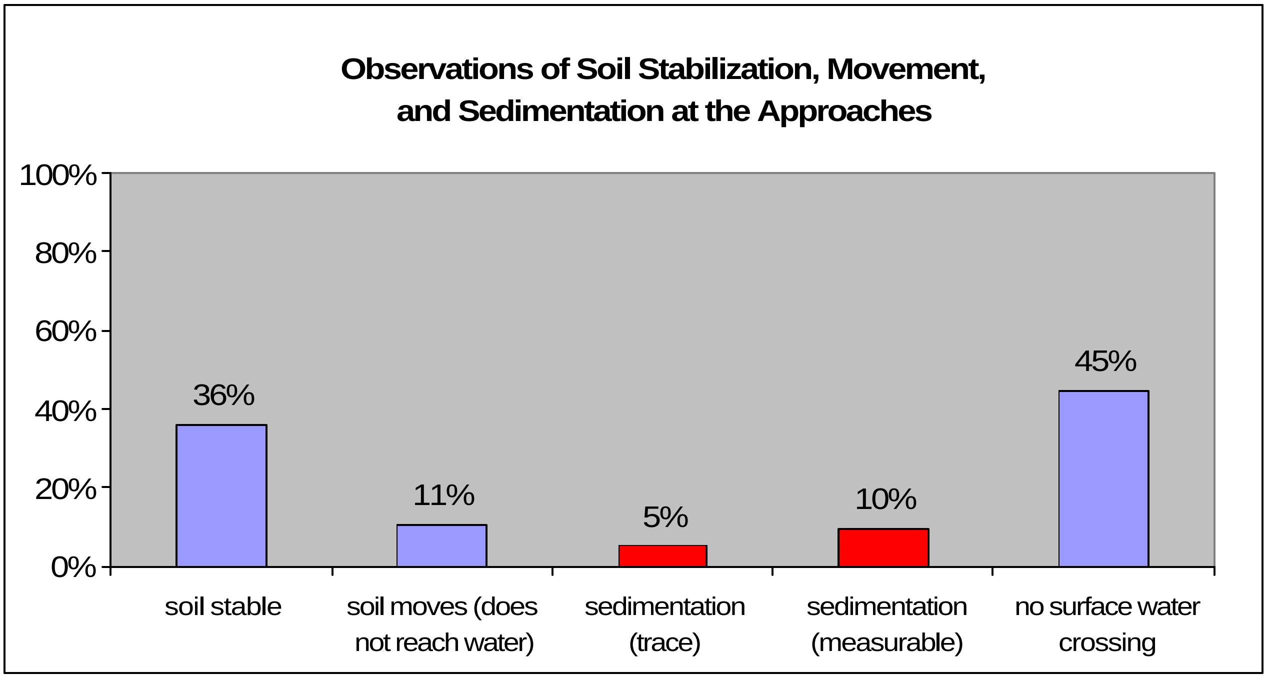


Figure 10 Proportions are based on the total number of opportunities to observe soil conditions at the approaches **(n=408)**.

Discussion

Of the 408 opportunities to observe soil conditions, 15% showed either trace or measurable amounts of sediment reached the waterbody. Excluding avoided stream crossings (45%), 28% of the approaches had either measurable or trace amounts of sediment reach the waterbody.

Sediment from the Approaches

There are **21** observations of trace amounts of sediment reaching the surface water body or deposited within bankfull channel width of the water feature.

There are **40** observations of measurable amounts of sediment reaching the surface water body or deposited within bankfull channel width of the water feature.

Specific Cause of Sedimentation from the Approaches

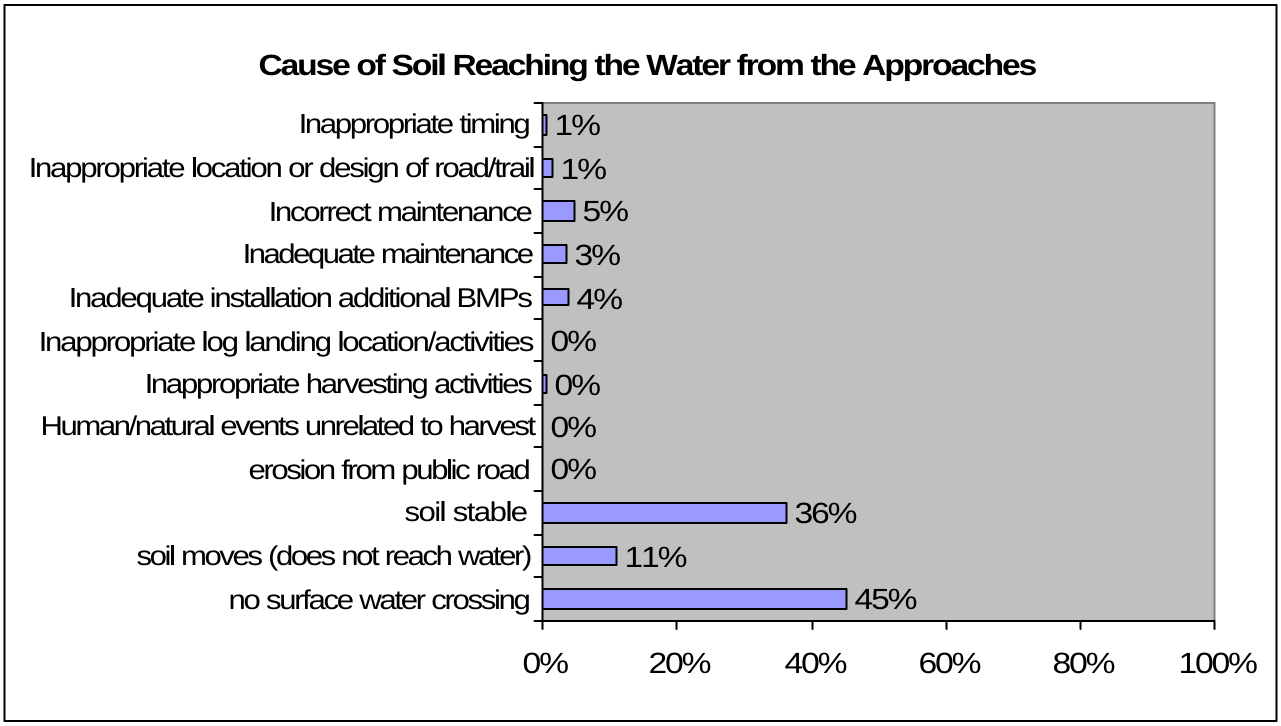


Figure 11 (n=408)

BMP Maintenance refers to reshaping or reinforcing installed BMPs to compensate for wear from use or erosion or in anticipation of seasonal shutdown or extreme weather events. Inadequate or incorrect BMP maintenance are the primary causes for sediment reaching the water from the approaches. Soil was stable at 65% of the approach observations when a crossing was present.

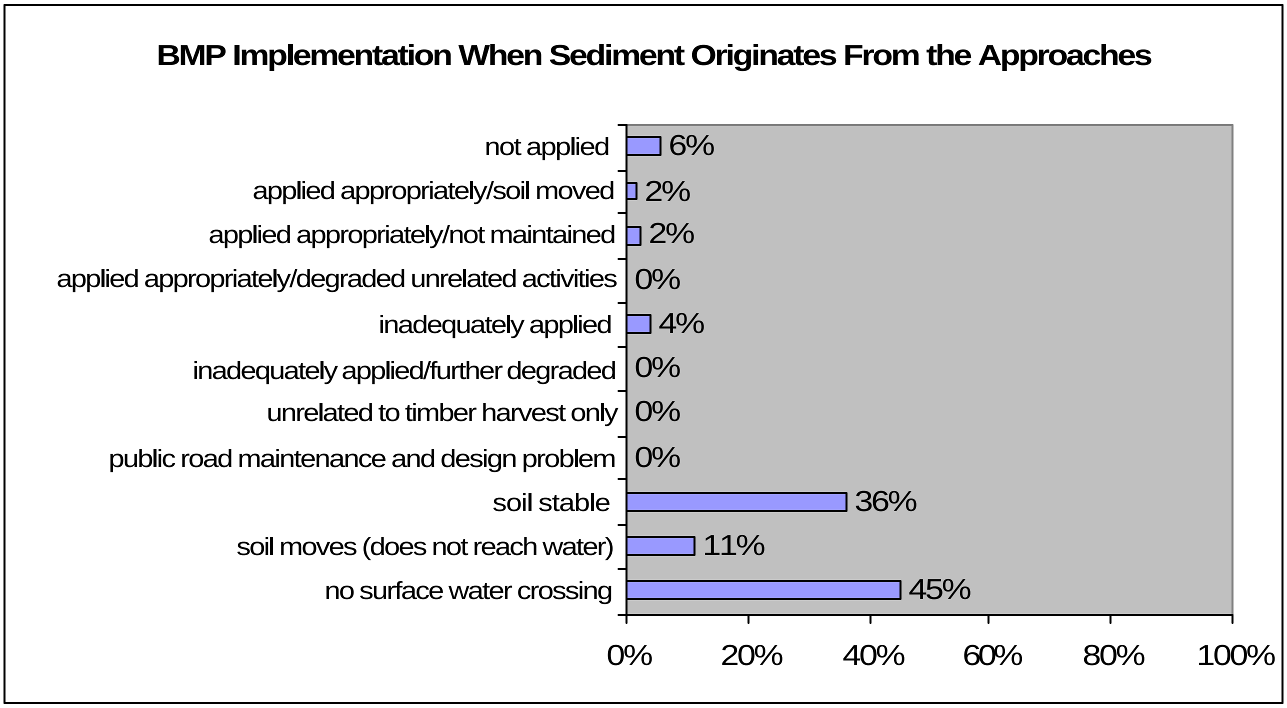


Figure 12 (n=408)

Discussion

15% of all observations showed soil movement into the waterbody originating from the approaches. Inadequate or incomplete application of BMP principles and practices resulted in sediment reaching the water at 25% (57 of 224) all observations at the approaches. Activities unrelated to the timber harvest (extreme weather, beavers, ATVs) accounted for the balance of observations where sediment reached the water from the crossing

Avoided water crossings and properly implemented BMPs prevented soil from reaching the water at 92% of the approach observations.

There are four equally important phases of BMP implementation;

1) Plan ahead - avoid water crossings, locate access roads, landings and trails properly, and time operations appropriately

2) Build it right - adequately apply initial BMP installations

3) Maintain it - monitor, repair and add additional BMPs as necessary during the active portion of the harvest

4) Close it out properly- identify long-term maintenance and monitoring needs, successfully establish soil stabilization, and anticipate activities unrelated to timber harvesting that may degrade final stabilization efforts.

Following BMPs through every stage of a harvest maximizes water resource protection and may reduce costs associated land management road maintenance and future forest management activities.

Crossing Structure

There is **one** opportunity to observe the occurrence of soil movement, soil sedimentation, or stabilization from the crossing structure. **Proportions are based on the total number of opportunities to make observations about soil conditions at the crossing structure.**

For the **102** new sample units, there are **102** opportunities to observe soil conditions at the crossing structure.

Soil Stabilization, Movement, and Sedimentation from the Crossing Structure

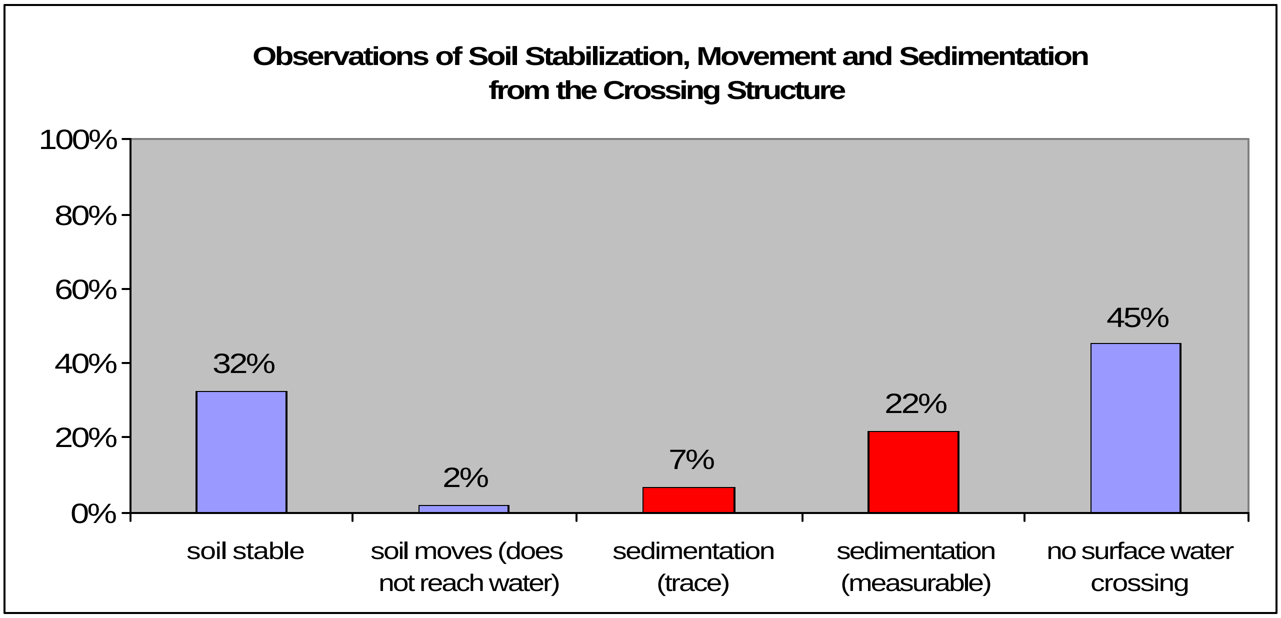
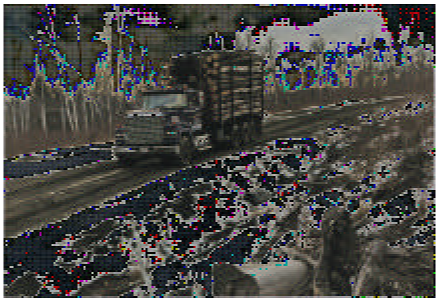


Figure 13 Proportions are based on the total number of opportunities to make observations about soil conditions at the crossing structure **(n=102)**.

<u>Discussion</u>

Fifty-six crossings where identified as either haul road or skid trail; 34 haul road, 22 skid trail. A haul road may be defined as forest access system designed to transport harvested forest products to a location or facility for resale, sorting or processing into value added forest products. Skid trails primarily bring trees that have been harvested to a concentration point directly associated with the forest operation notification for either further preparation for transport on a haul road or public transportation route. Haul road stream crossings were evaluated if they were directly associated with the sample unit. Haul road crossings associated with multiple harvests or large amounts of acreage not directly associated with harvest were not evaluated.



Haul Road

Skid Trail

Sedimentation from the Crossing Structure

There are **7** observations of trace amounts of sediment reaching the surface water body or deposited within bankfull channel width of the water feature.

There are **22** observations of measurable amounts of sediment reaching the surface water body or deposited within bankfull channel width of the water feature.

Structure Type Associated with Sedimentation

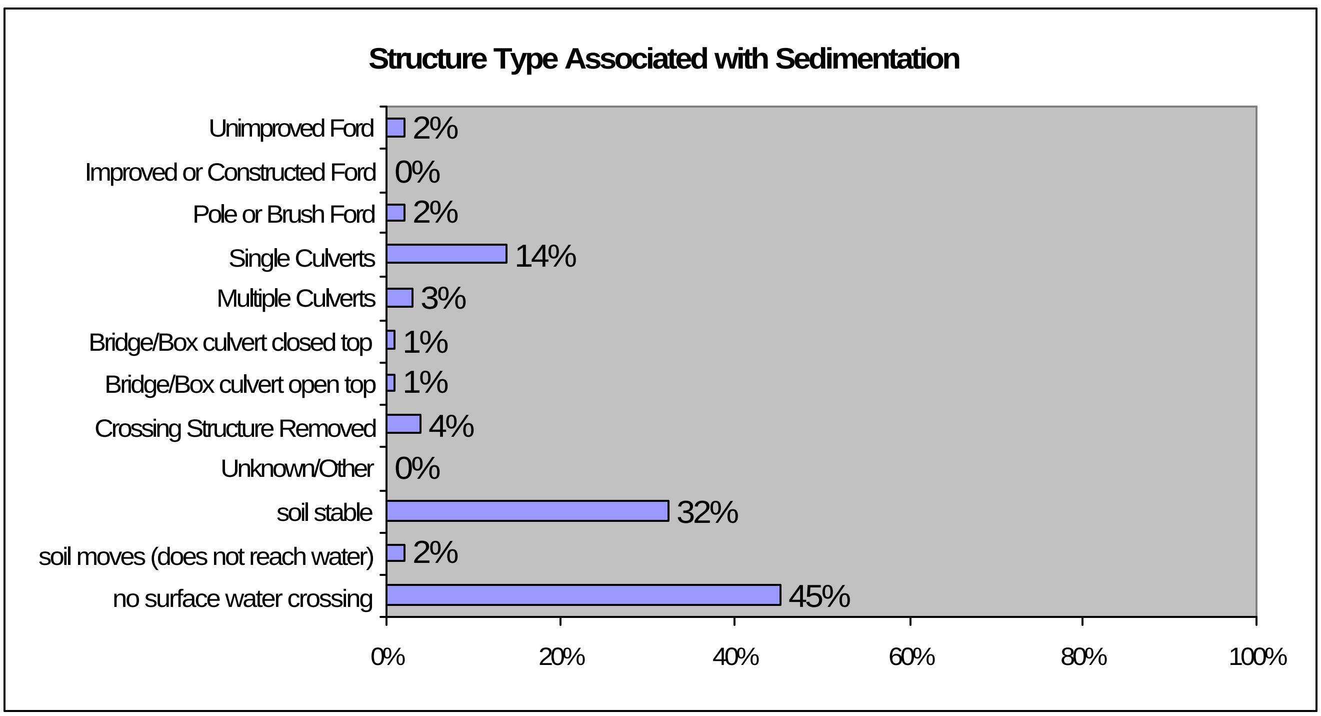
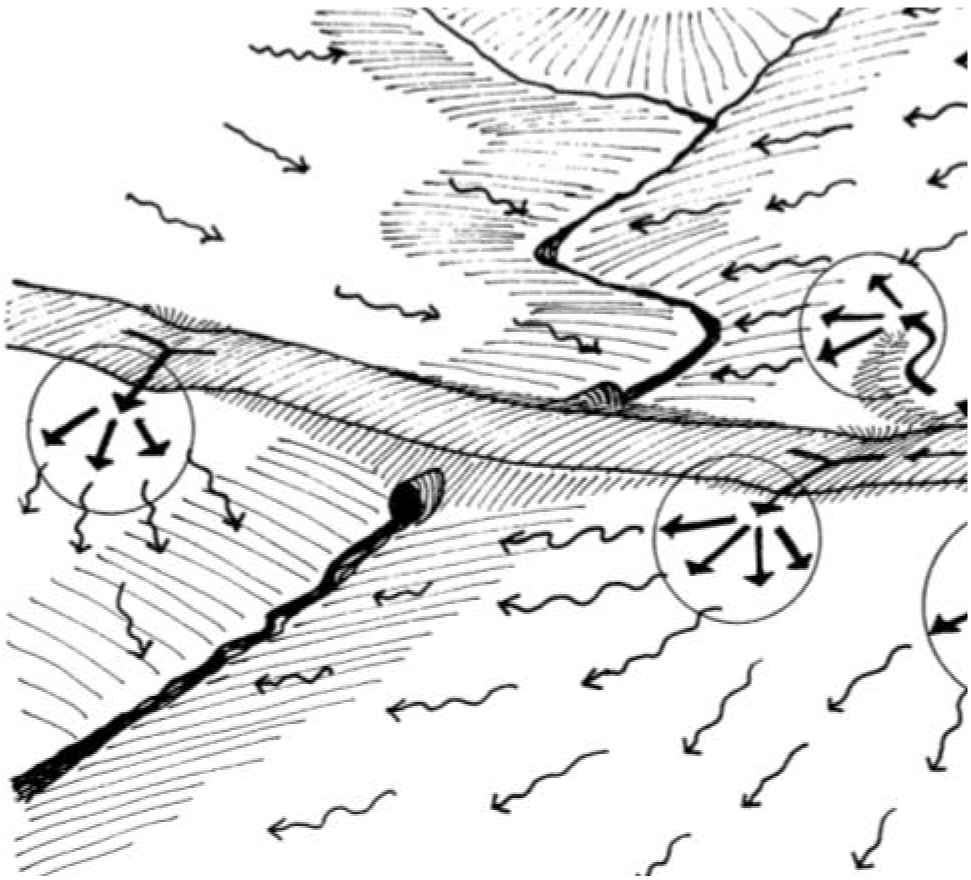


Figure 14 (n=102)

Elevated crossing structures, crossings not at the lowest point in the road profile, divert storm flow into adjacent filter areas. By elevating the approaches inside the buffer/filter strip, stormwater can be easily diverted away from the crossing structure. Crossings located at the lowest point of the road profile often fail prematurely from side embankment erosion immediately adjacent to the structure.

Note elevated crossing diverting water flow into filter areas



Structure Type Associated with Observations of Trace Sediment vs. Measurable Sediment

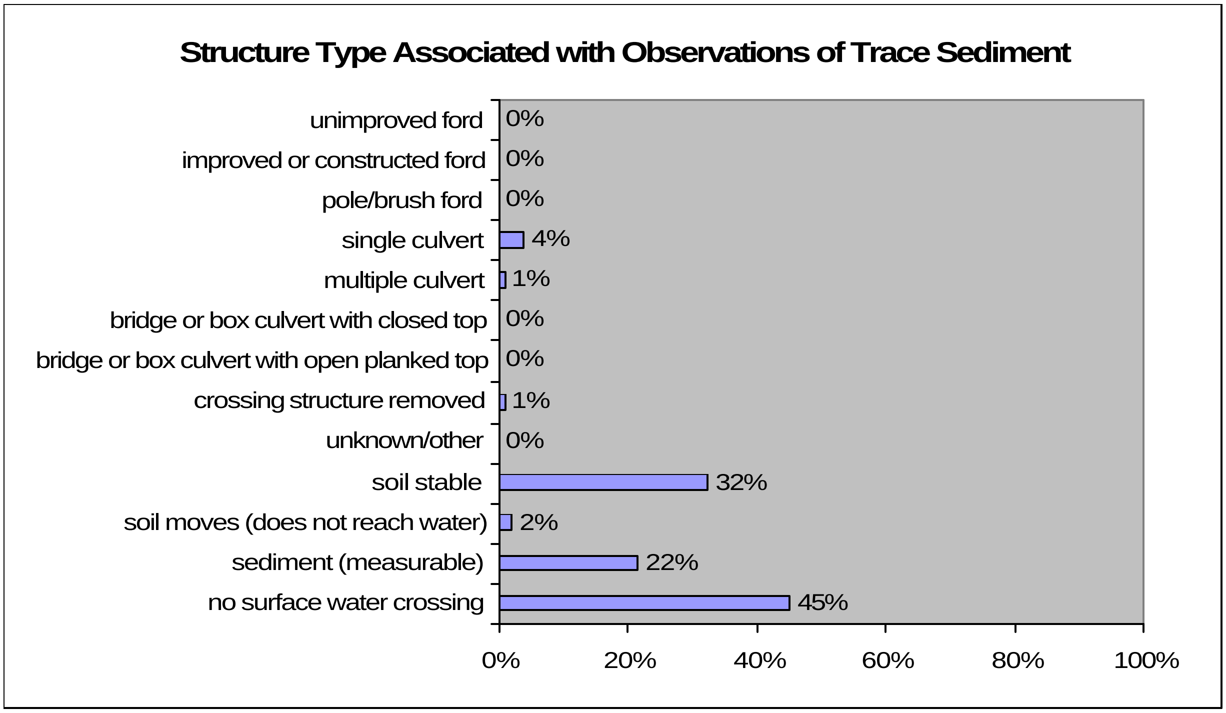


Figure 15 Proportions are based on the total number of opportunities to observe sediment delivery from the crossing structure **(n=102).**

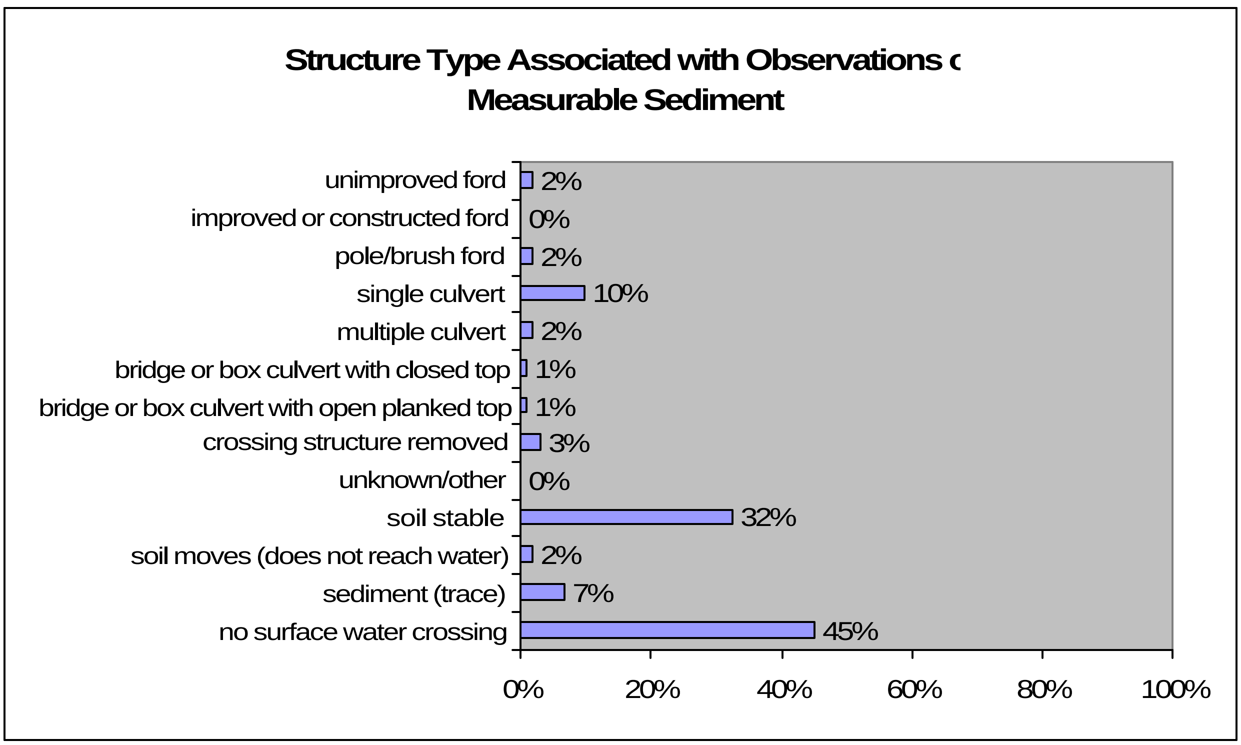


Figure 16 Proportions are based on the total number of opportunities to observe sediment delivery from the crossing structure **(n=102).**

Activities Related to Sedimentation

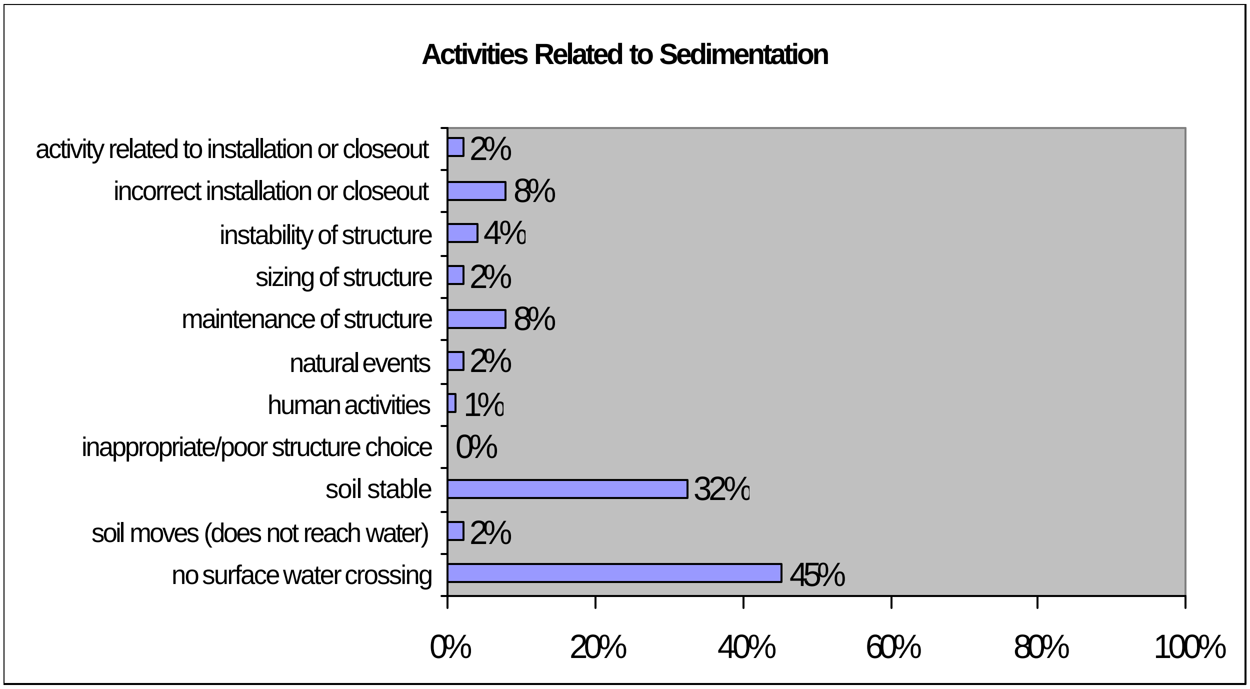


Figure 17 (n=102)

Sedimentation Related to Application of BMP Principles and Practices

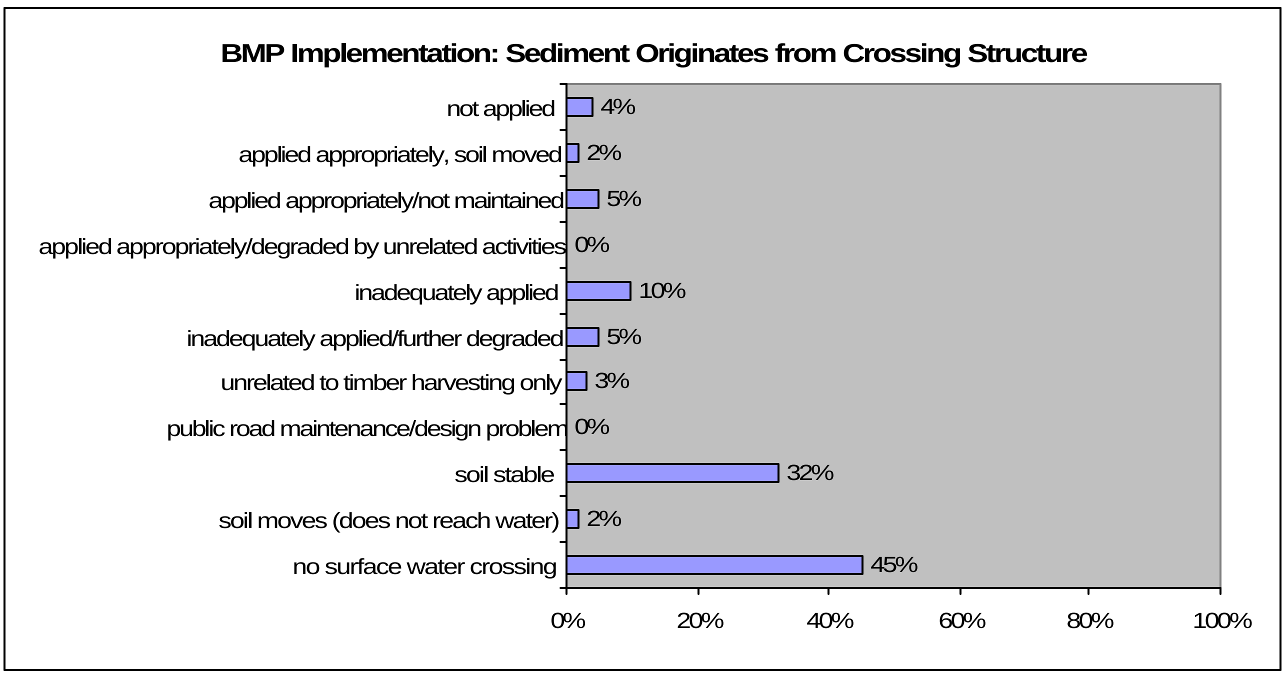


Figure 18 (n=102)

Discussion

29% of all observations showed soil movement into the waterbody originating from the crossing. Inadequate or incomplete application of BMP principles and practices resulted in sediment reaching the water at 44% (24 of 56 observations) of all crossings. Activities unrelated to the timber harvest (extreme weather, beavers, ATVs) accounted for the balance of observations where sediment reached the water from the crossing

Avoided water crossings and properly implemented BMPs prevented soil from reaching the water at 79% of the crossing observations.

***BMP Principle**: Protect the Integrity of Waterbodies*

Crossing Structure Specifications

A total of **102** new sample units were sampled.

- **56** sample units have surface water crossings.

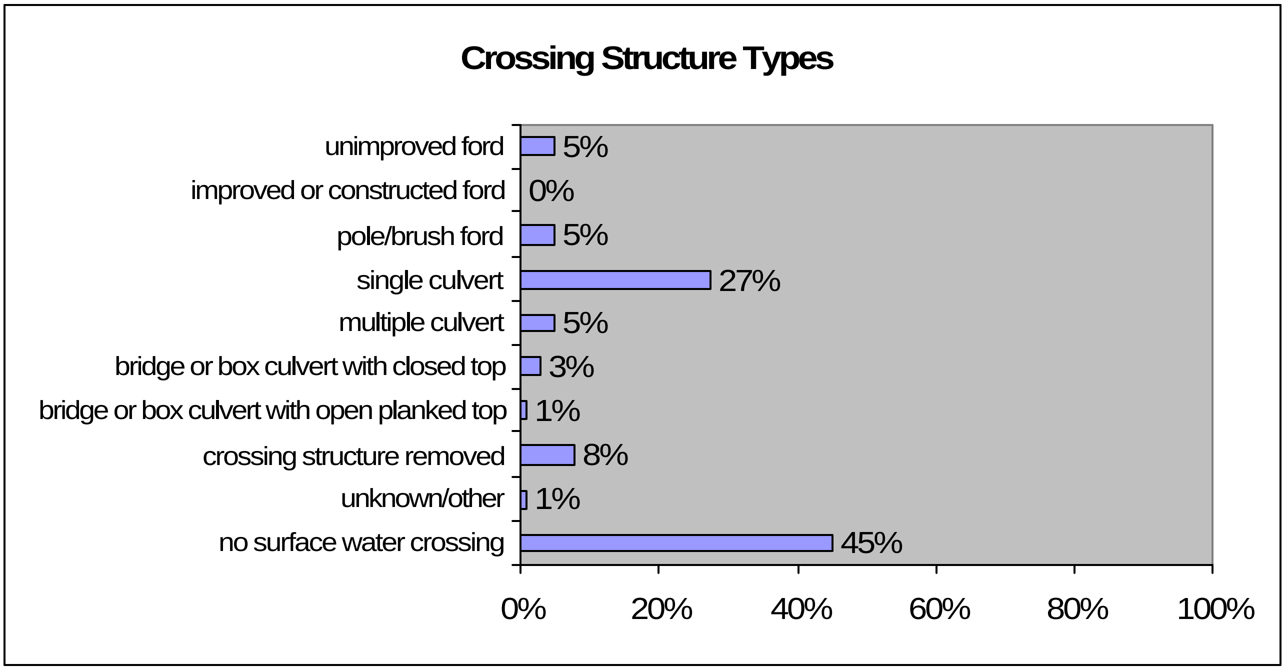


Figure 19 Proportion of crossing structure types based on total possible number of crossing structures **(n=102)**.

Structure Type by Road Type

- There are **22** sample units with a skid trail at the water crossing.
- There are **34** sample units with a haul road at the water crossing.

The following charts compare crossing structure types by road type at the water crossing.

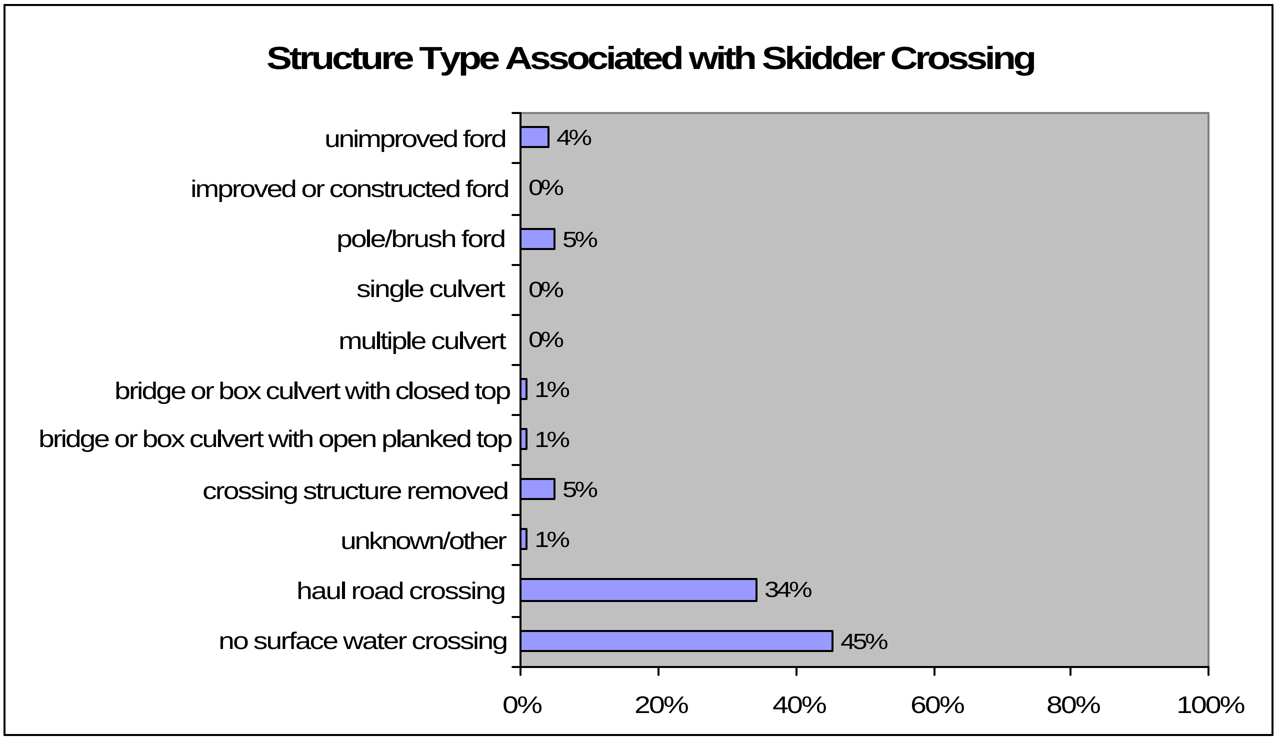


Figure 20 Proportion of crossing structure types based on total possible number of crossing structures **(n=102)**.

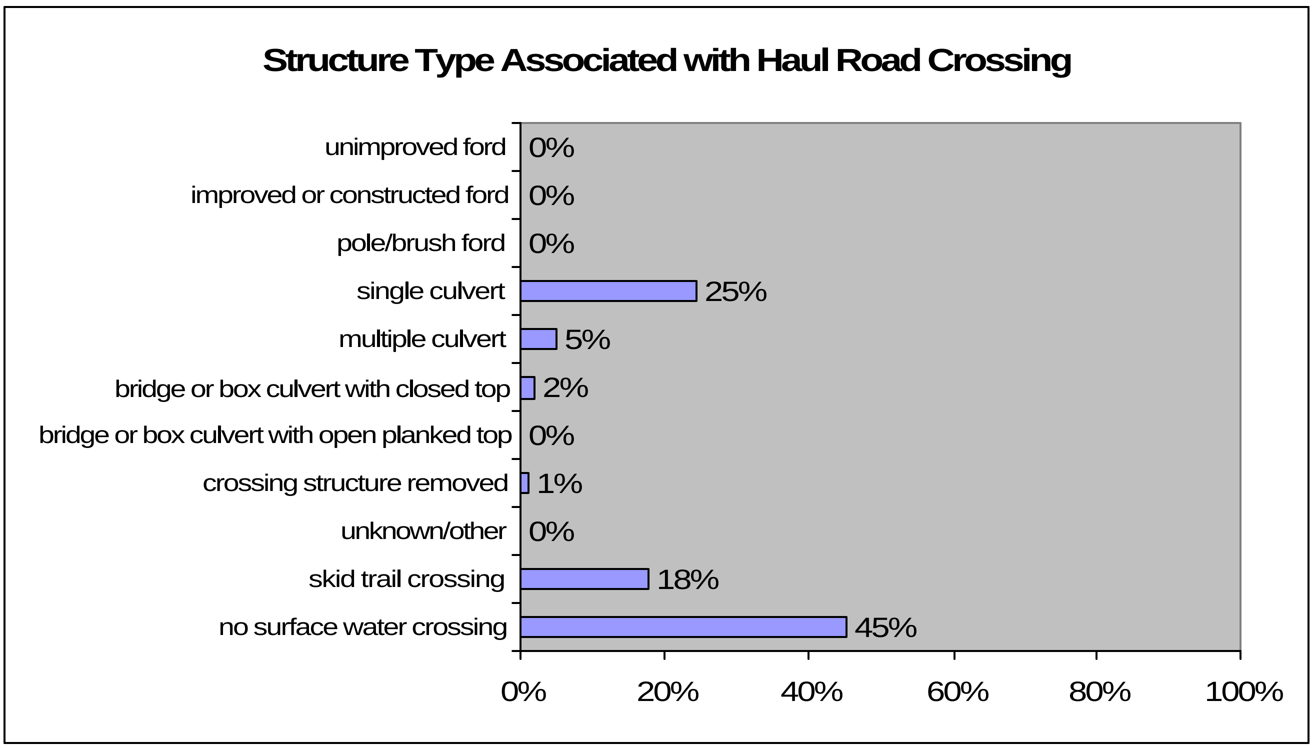


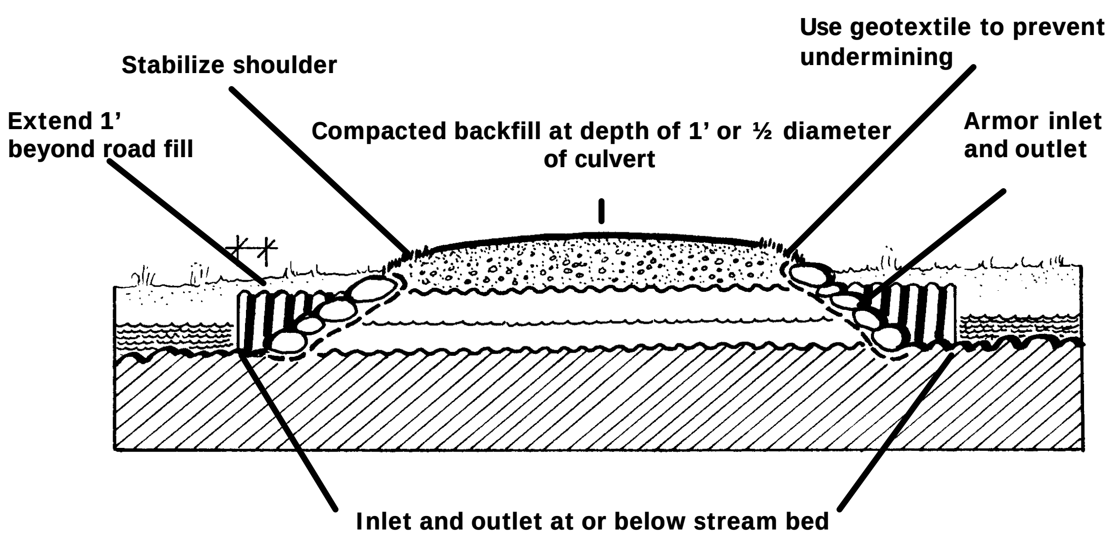
Figure 21 Proportion of crossing structure types based on total possible number of crossing structures **(n=102)**.

Discussion

It is imperative that permanent structures be designed and installed according to minimum standards and BMP recommended guidelines. Proper installation maximizes the useful life of the crossing structure thus reducing maintenance and unnecessary replacement costs due to premature failure.

The majority crossing type is a single culvert on a haul road. 82% of single culverts are expected to be in place greater than three months. Single culverts are also the most prevalent structure delivering sediment to the water feature.

When installing permanent crossings



Structure Type Associated with Down cutting or Scouring within 100' of the Outlet

- There are **21** observations of stream *downcutting* or *scouring* within 100 feet of the outlet end of the structure.
- **42** sample units show no evidence of stream downcutting or scouring within 100 feet of the outlet end of the structure.

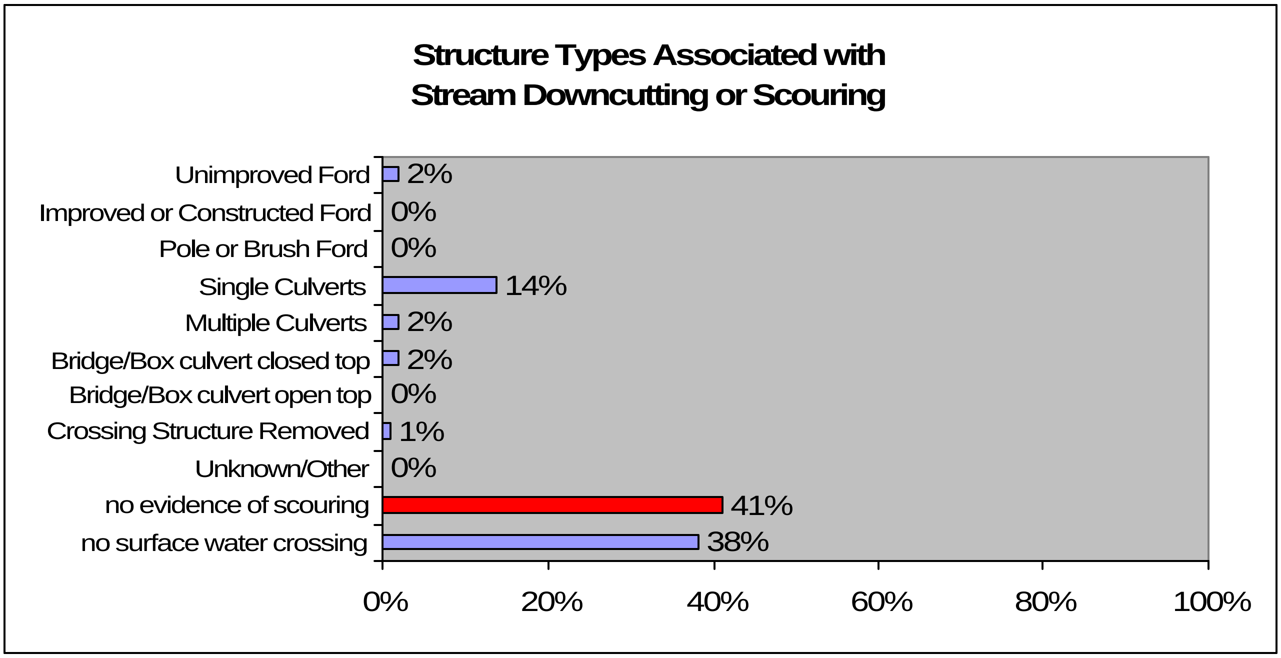


Figure 22 (n=102)

Structure Opening

- **15** have a width or remnant opening equal to or greater than bankfull channel width.
- **41** have a width or remnant opening less than bankfull channel width.

<u>Discussion</u>

14 of 21 (67%) observations with downcutting or scouring were associated with single culverts. Single culverts were the predominant crossing structure used to cross both perennial and intermittent streams**.** Outlet downcutting and scouring are indicative of undersized structures that restrict normal stream by not extending to the stream bank width. Undersized structures inhibit aquatic organism passage by restricting and concentrating flow.

Properly installed crossings do not constrict the stream bed to fit the size of the structure. Undersized structures in place for over 3 months can inhibit aquatic organism passage by creating velocity, jump, and debris barriers. When replacing washed out or failing crossing structures, ***current*** minimum size standards should be applied to avoid premature structure failure and ensure stream channel connectivity.

Fish Passage

Presence of Fish and Macro-invertebrates

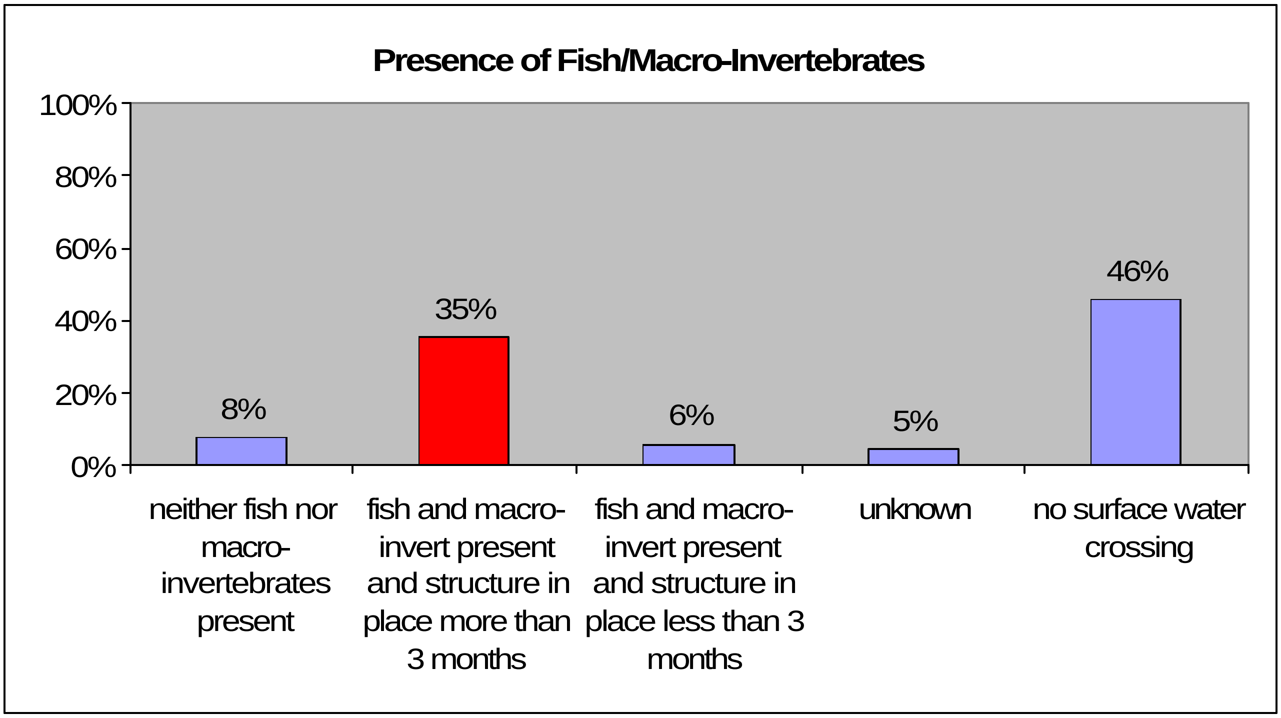


Figure 23 (n=102)

Streambed Conditions When Fish and Macro-invertebrates Present and Crossing Structure is in Place More than Three Months

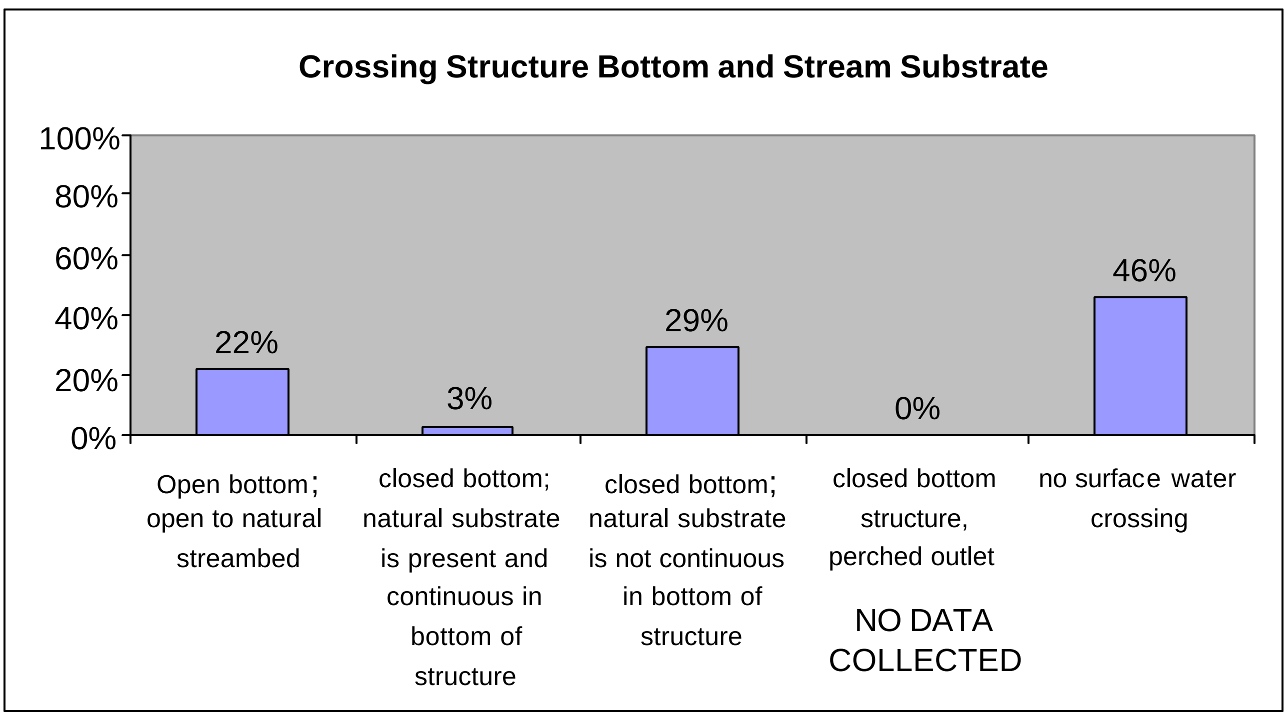


Figure 24 (n=102)

Table 1

Percent of structure types not meeting BMP recommended minimal opening size and in place greater than three months

Structure Type	% Undersized and in place > 3 months	Proportional % of all crossings
Unimproved ford	0	0
Improved or constructed ford	0	0
Pole/brush ford	33	2
Single culverts	82	25
Multiple culverts	100	7
Bridge or box culvert with closed top	100	5
Bridge or box culvert with open planked top	100	2
Crossing structure removed	0	0
Unknown/other	0	0

Discussion

Characteristics of improperly installed crossings include: 1) passage barriers for fish, amphibians and macro invertebrates, 2) bank instability from inadequate compaction and excessive slopes, 3) alteration of stream flow, 4) inadequate maintenance, and 5) premature failure often preceded by prolonged erosion.

Conversely, stream crossing structures which are properly sized and installed according to best management practices: 1) maintain natural stream substrate within the structure, eliminating most passage barriers, 2) provide embankment grade stabilization from reduced slopes, 3) maintain natural stream flow by extending bank to bank, 4) disperse road drainage into filter areas, and 5) reduce land management road costs by prolonging useful life of the crossing structure.

Soil Movement through the Buffer/Filter Strip (soil did not reach surface water body)

Buffer/Filter Strip Width is Between 25 and 49 Feet

Sample units in this section have a buffer/filter strip width between 25 and 49 feet.

- **32** sample units have a buffer/filter strip width between 25 and 49 feet.

There are **two** opportunities to observe the occurrence of soil movement through the buffer/filter strip—approach A inside the buffer/filter strip and approach B inside the buffer/filter strip. **Proportions are based on the total number of opportunities to make observations about soil conditions at the approaches inside the buffer/filter strip.**

For the **32** new sample units, there are **64** opportunities to observe soil movement through the buffer/filter strip.

- There are **7** observations of soil movement through the buffer/filter strip that did not reach the surface water body.

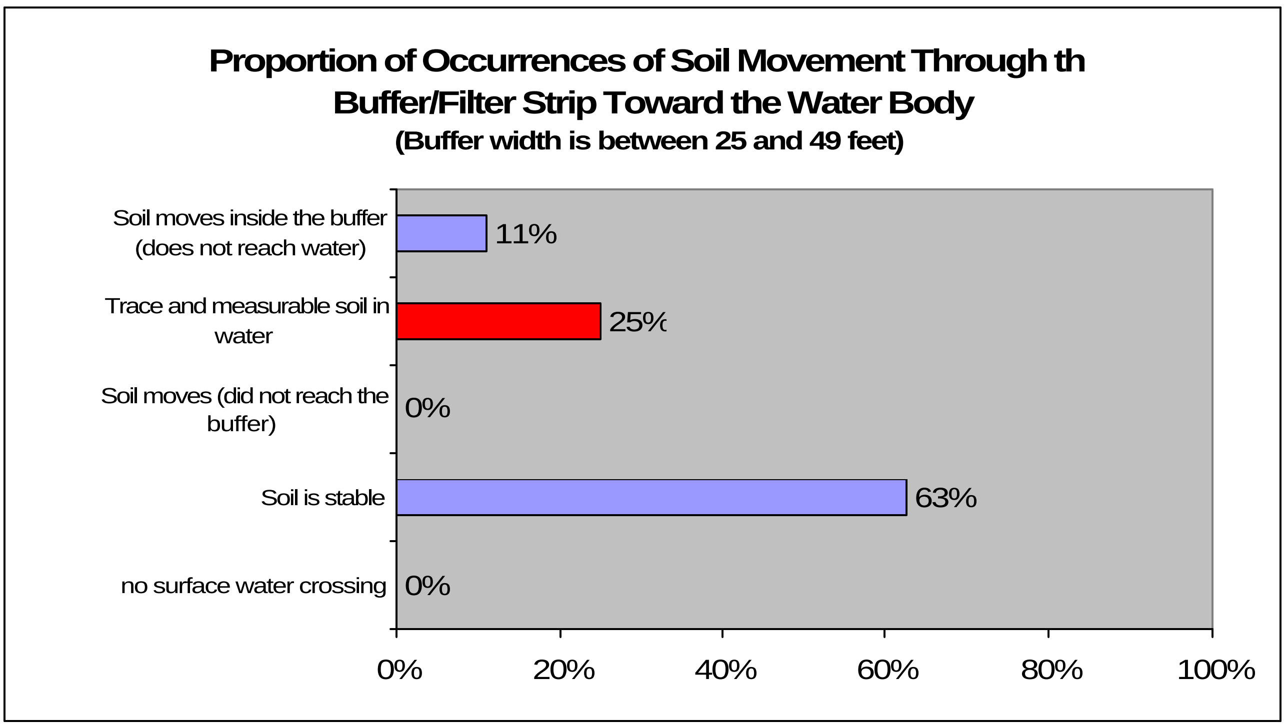


Figure 25 (n=64)

Soil Type in the Buffer/Filter Strips Where Soil Movement was observed

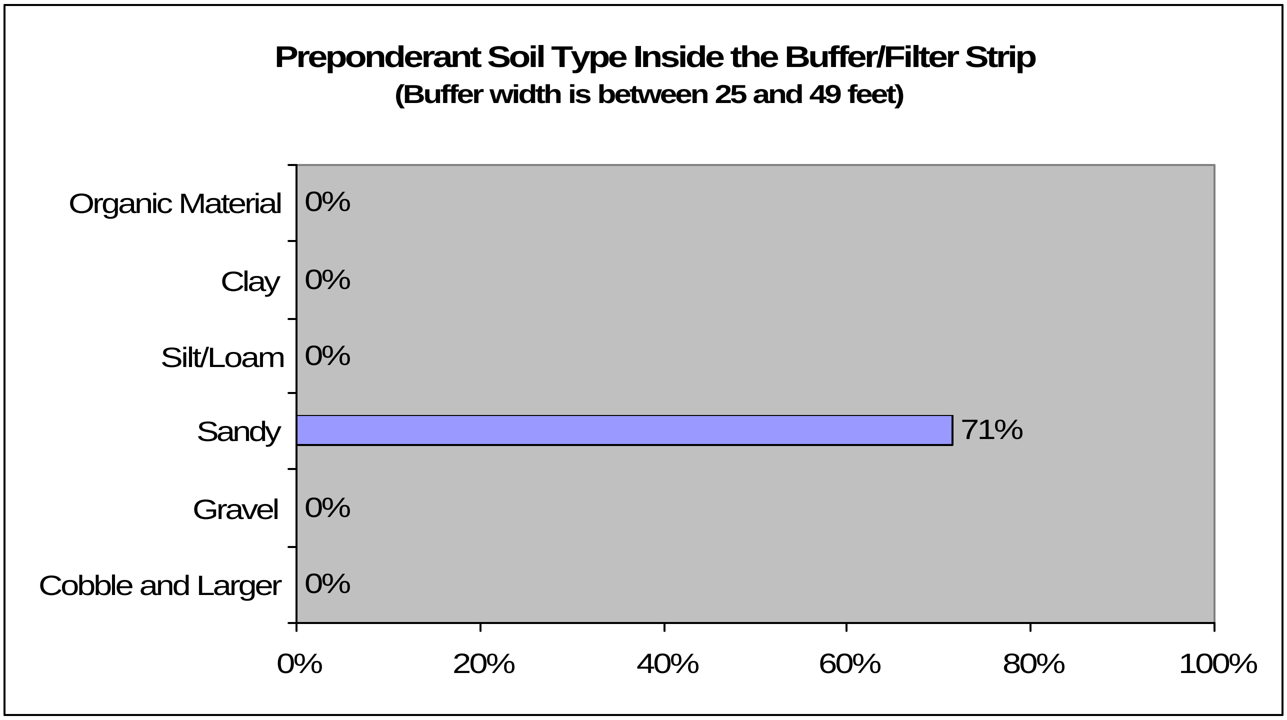


Figure 26 (n=7)

Percent Distance Soil Moved Through the Buffer/Filter Strip Toward the Water Body

Distance soil moved through the buffer toward the water body was recorded as a percentage of the width of the buffer/filter strip. The percentages below reflect sample units with a buffer/filter strip width between 25 and 49 feet.

	Inside the Buffer (Approaches A and B combined)	Approach A–Inside the Buffer	Approach B–Inside the Buffer
Average	58	77	44
Median	70	80	45
Maximum	90	90	80

Table 2 Non-numeric values indicate that no distance measurements were recorded.

Specific Cause of Soil Movement in the Buffer/Filter Strip

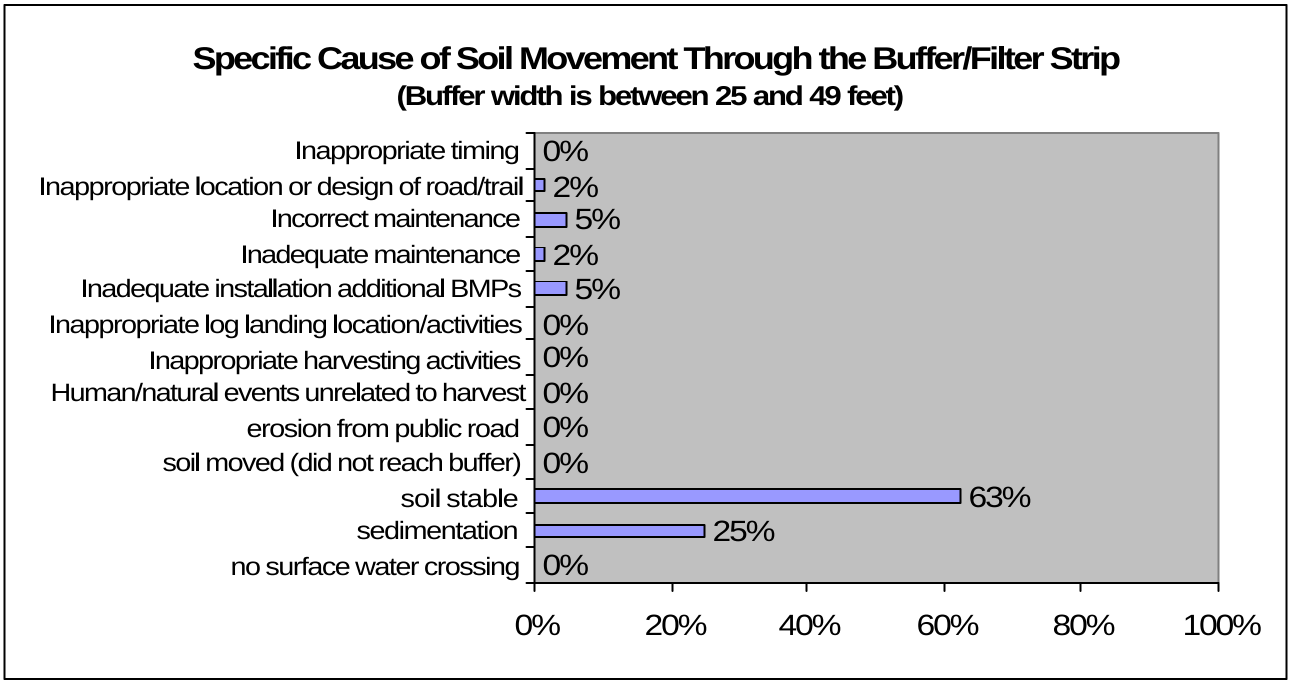


Figure 27 (n=64)

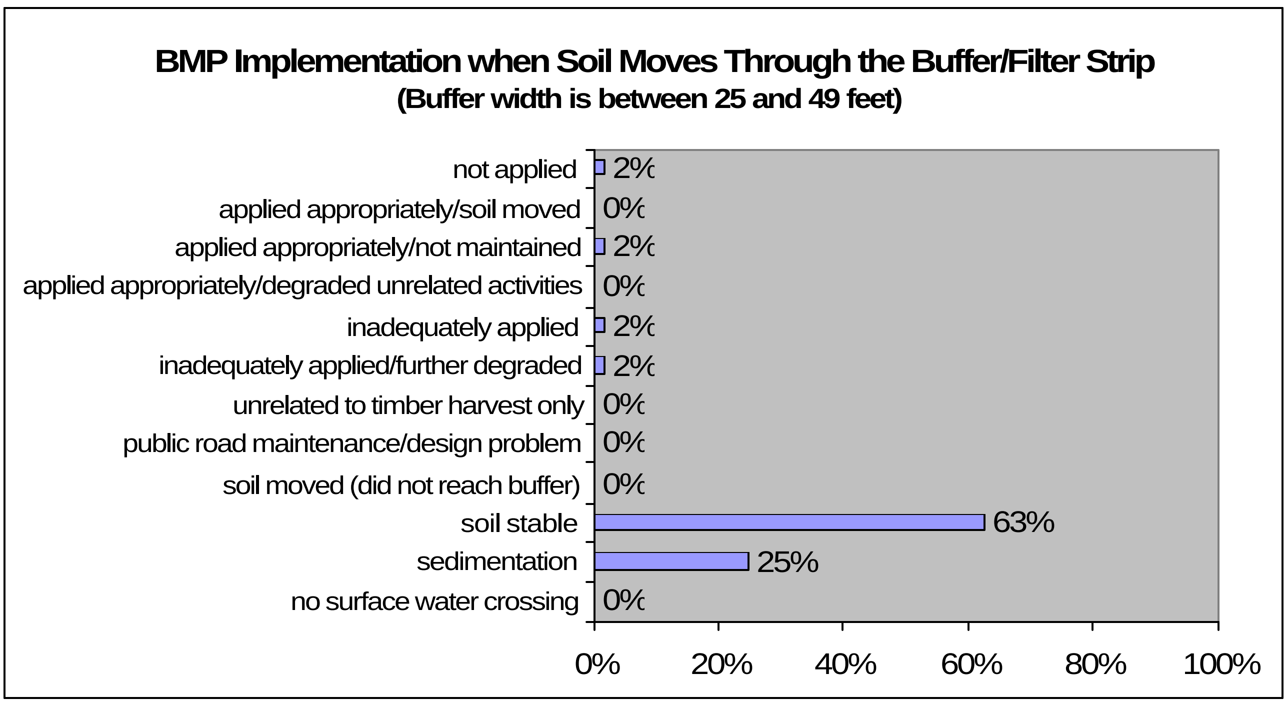


Figure 28 (n=64)

Buffer/Filter Strip Width is Greater than or Equal to 50 Feet

Sample units in this section have a recommended buffer/filter strip width greater than or equal to 50 feet.

- **23** sample units have a recommended buffer/filter strip width greater than or equal to 50 feet.

There are **two** opportunities to observe the occurrence of soil movement through the buffer/filter strip—approach A inside the buffer/filter strip and approach B inside the buffer/filter strip. **Proportions are based on the total number of opportunities to make observations about soil conditions at the approaches inside the buffer/filter strip.**

For the **23** new sample units, there are **46** opportunities to observe soil movement through the buffer/filter strip.

- There are **7** observations of soil movement through the buffer/filter strip that did not reach the surface water body.

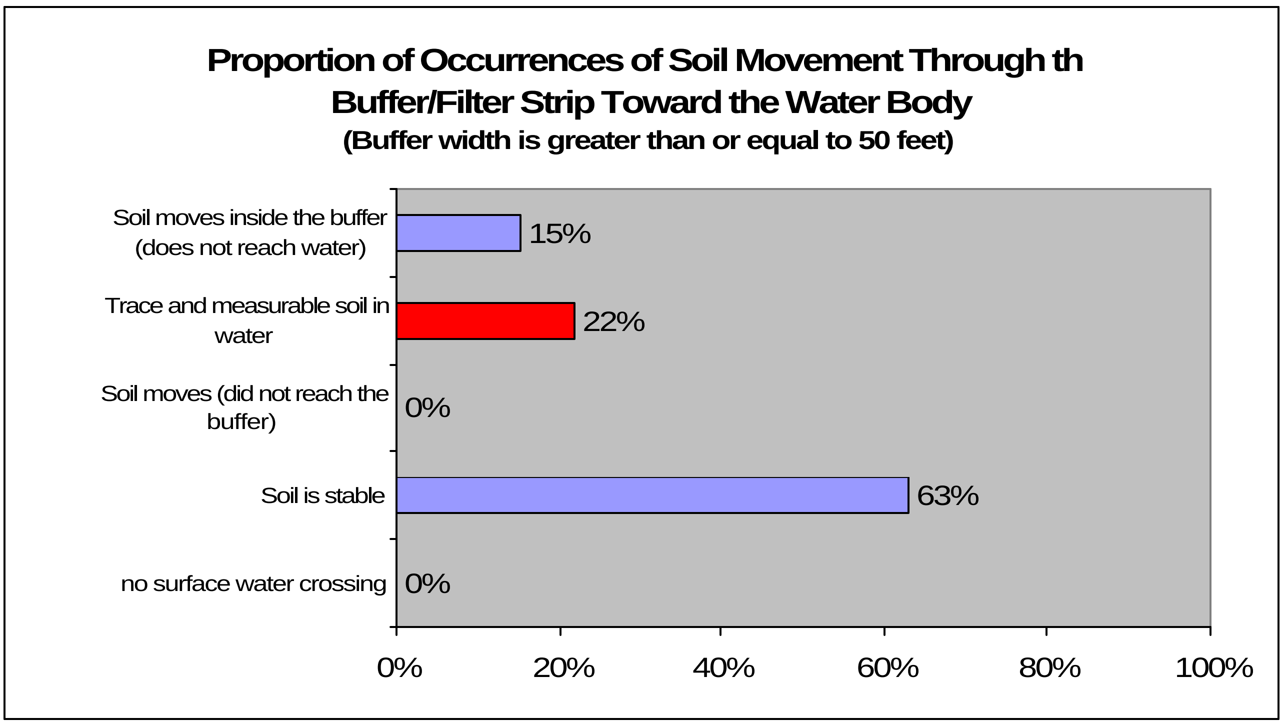


Figure 29 (n=46)

Soil Type in the Buffer/Filter Strips Where Soil Movement was Observed

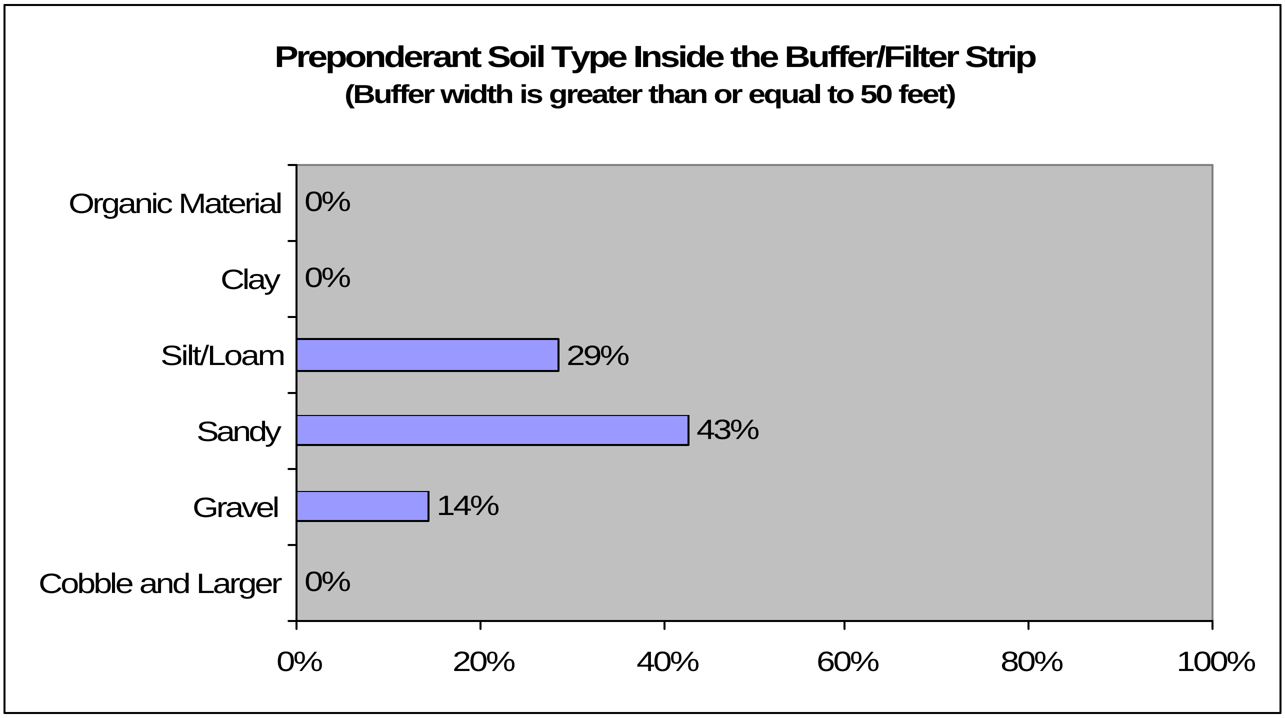


Figure 30 (n=7)

Percent Distance Soil Moved Through the Buffer/Filter Strip toward the Water Body

Distance soil moved through the buffer toward the water body was recorded as a percentage of the width of the buffer/filter strip. The percentages below reflect sample units with a recommended buffer/filter strip width greater than or equal to 50 feet.

	Inside the Buffer (Approaches A and B combined)	Approach A– Inside the Buffer	Approach B– Inside the Buffer
Average	38	38	0
Median	20	20	0
Maximum	80	80	0

Table 3 Non-numeric values indicate that no distance measurements were recorded.

Specific Cause of Soil Movement in the Buffer/Filter Strip

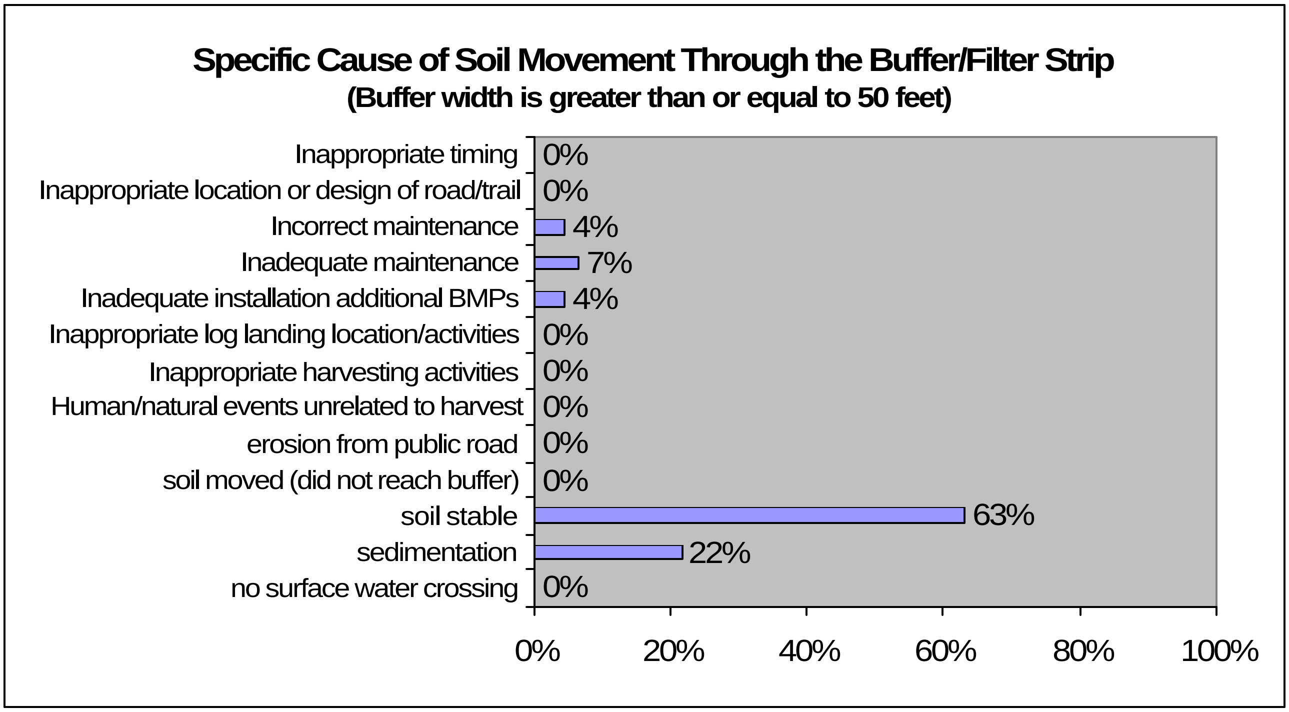


Table 31 (n=46)

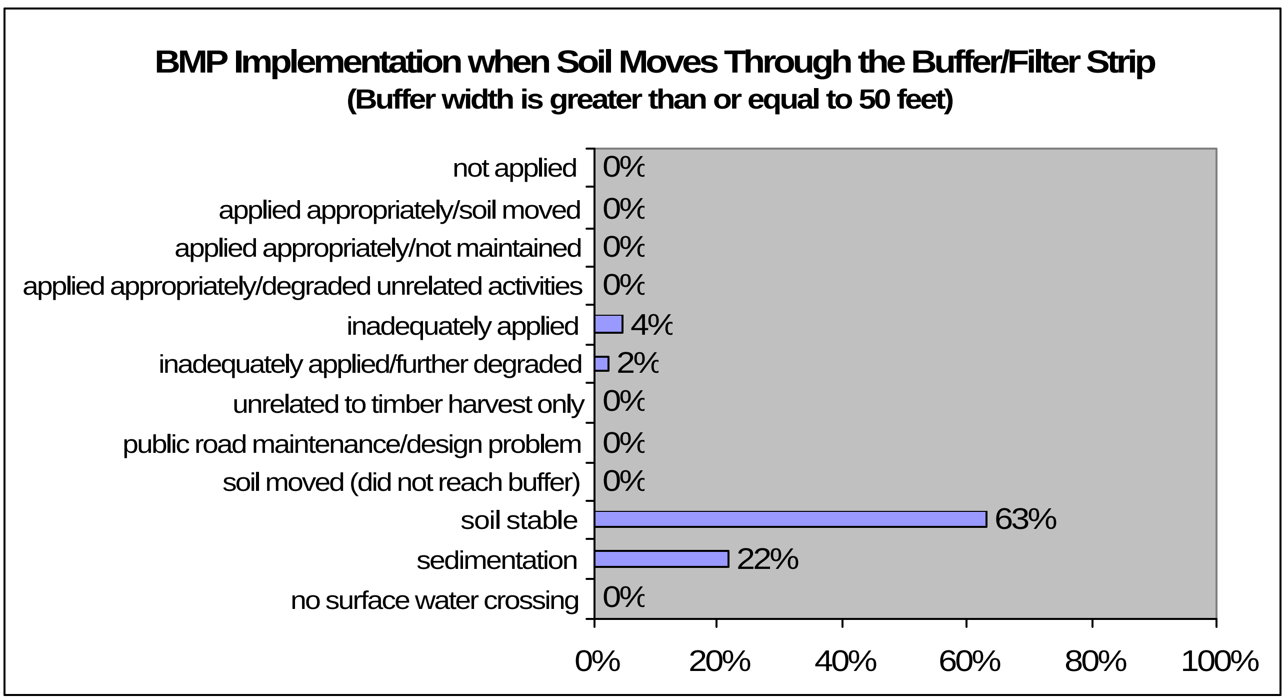


Table 32 (n=46)

Discussion

Soil movement studies show when evidence of deposited soil exists beyond 50% width of the buffer/filter strip, it is likely that sediment will eventually reach the waterbody. MFS recommends adding additional BMP practices to slow down and spread out water flow when this condition is observed.

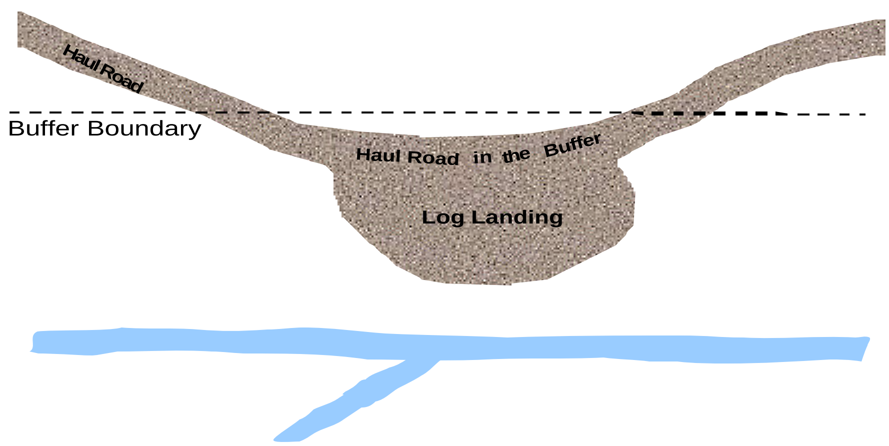
Haul Road or Log Landing in Buffer

There is **one** opportunity to observe the occurrence of soil movement, soil sedimentation, or stabilization from the haul road or log landing inside the buffer/filter strip. **Proportions are based on the total number of opportunities to make observations about soil conditions at the haul road or log landing inside the buffer.**

For the **102** new sample units, there are **102** opportunities to observe soil conditions at the haul road or log landing inside the buffer.

- **3** sample units have a haul road or log landing located within the buffer/filter strip.

Haul Road and Landing in a Buffer Filter Strip



Soil Stabilization, Movement, and Sedimentation

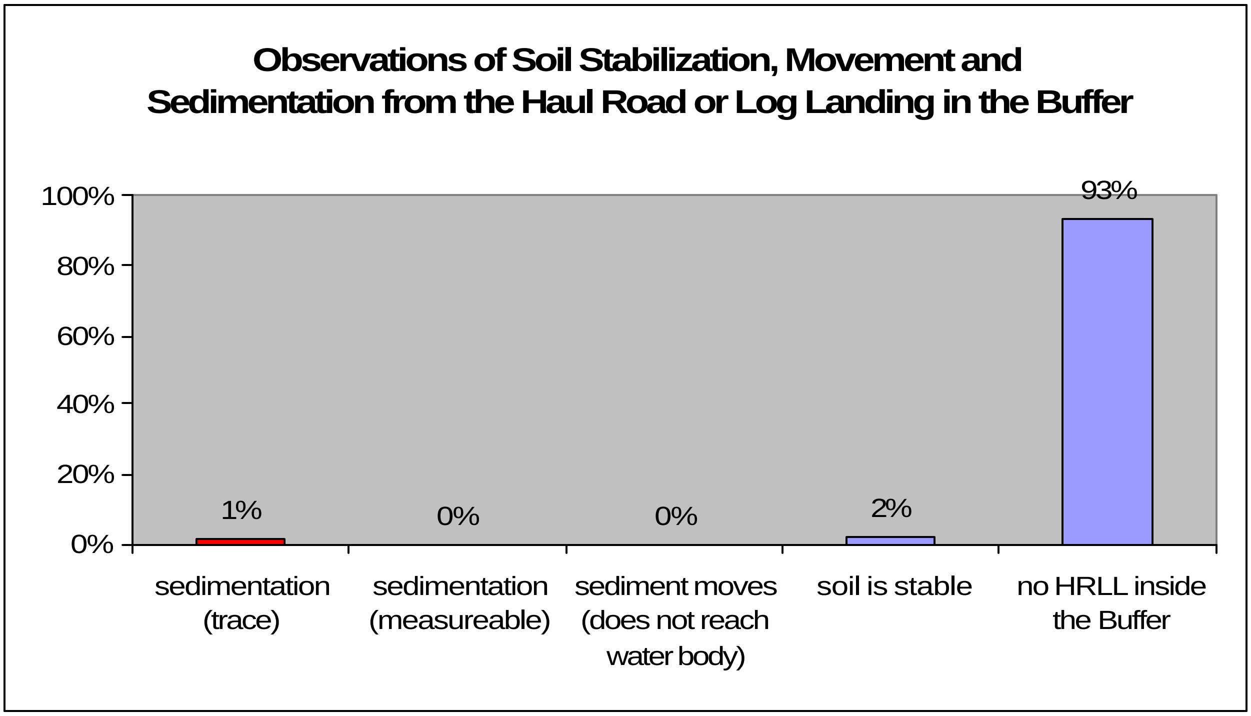


Figure 33 Proportions are based on the total number of opportunities to make observations about soil conditions at haul road/log landings inside the buffer/filter strip **(n=102)**.

Sedimentation from the Haul Road/Log Landing in the Buffer

There are **1** observation(s) of trace amounts of sediment reaching the surface water body or deposited within bankfull width of the channel.

There are **0** observations of measurable amounts of sediment reaching the surface water body or deposited within bankfull width of the channel.

Soil Type in the Buffer/Filter Strips Where Sedimentation was Observed

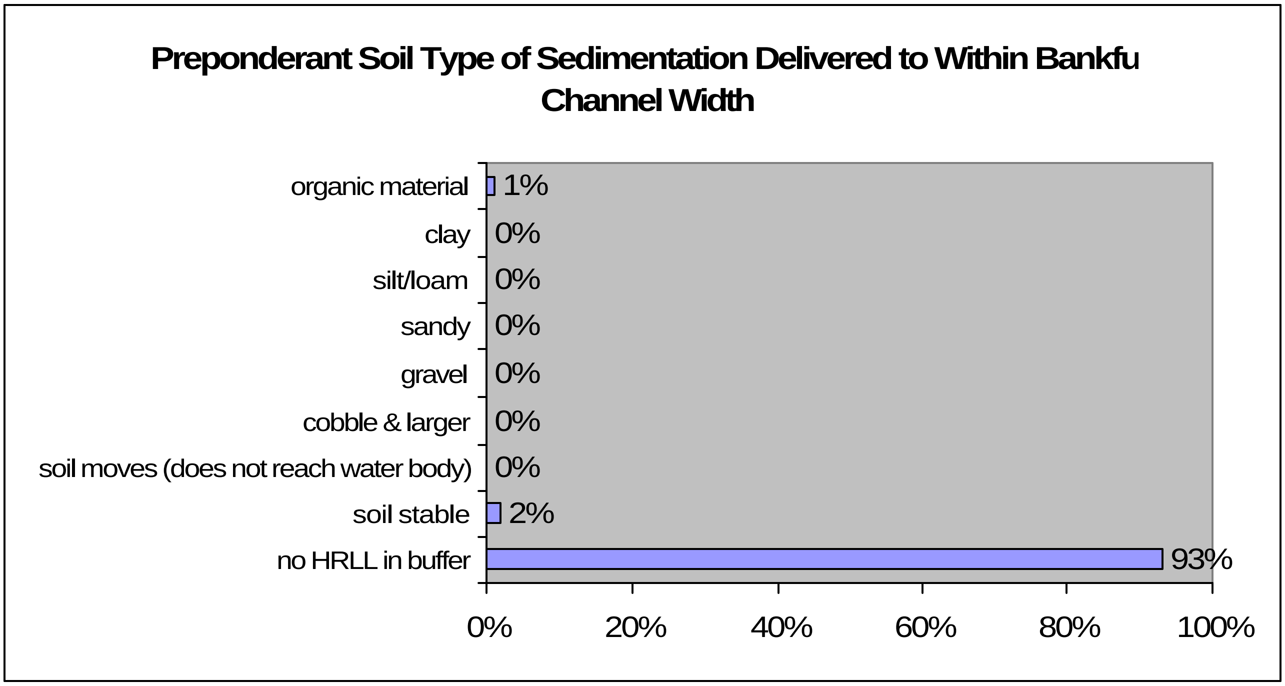
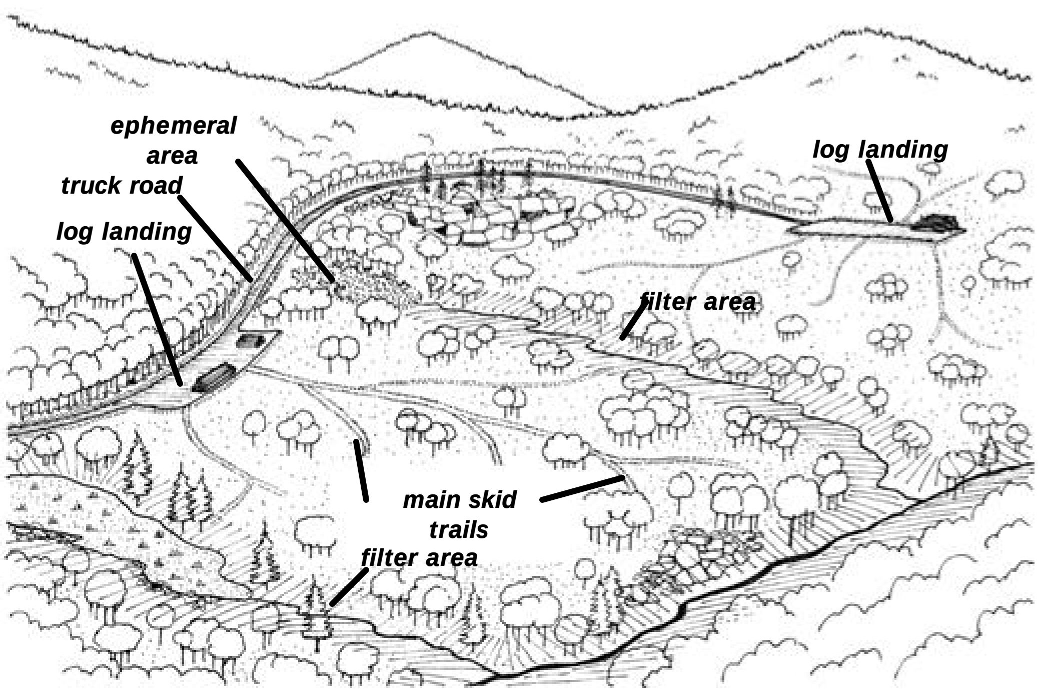


Figure 34 (n=102)

Select haul road and landing locations carefully

Illustration 6



Specific Cause of Sedimentation

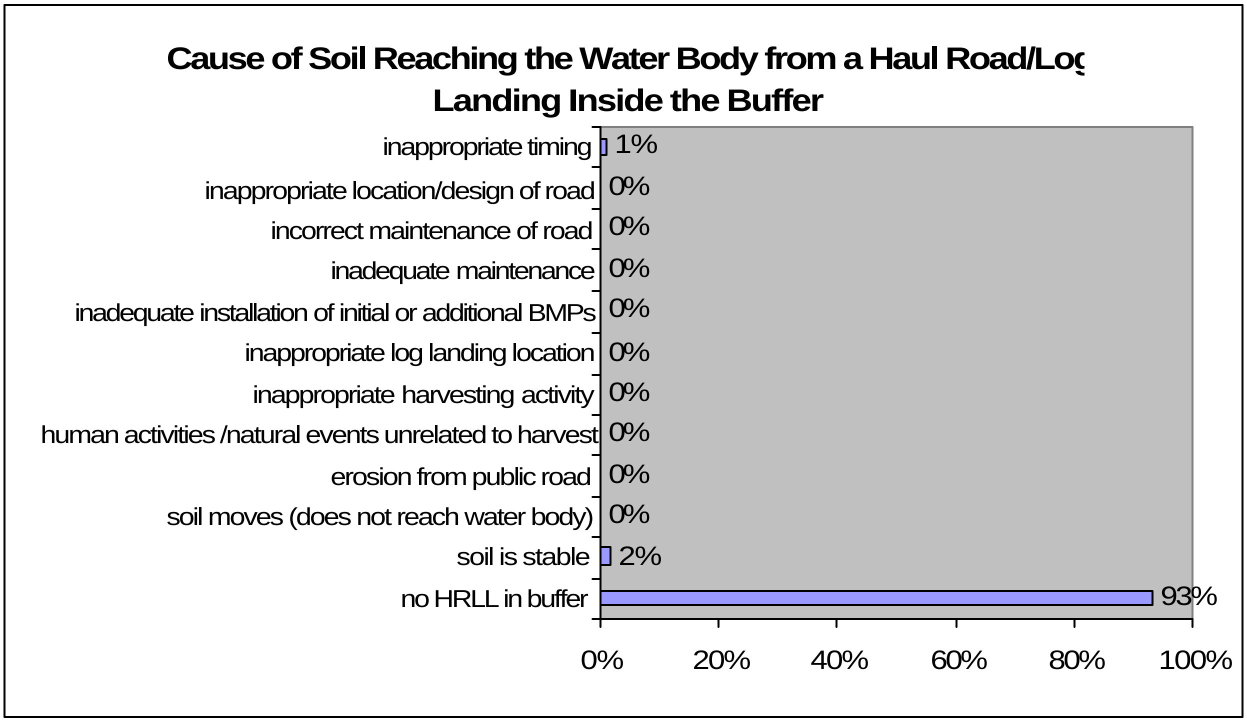


Figure 35 (n=102)

Discussion

Areas of prolonged exposed soil during a given timber harvest are typically located on haul roads and landings. These locations pose the greatest risk to adjacent water resources from soil movement and potential chemical contamination from fuel oil and maintenance fluid use and storage. Locating haul roads and landings outside buffer filter strip, significantly reduces environmental risk and BMP implementation costs.

93% of timber harvests monitored did not have landings or haul roads within the buffer. New construction typically avoids placing these forest access systems within these sensitive areas. Practitioners routinely scrutinize appropriateness of reuse when accessing historical haul roads and skid trails to regain access to areas that have not been harvested in recent years.

As with other findings, analysis shows when BMPs are applied, negative impacts to forested water resources are greatly reduced if not totally eliminated. Locating haul roads and landings outside the buffer during the pre-harvest planning is an effective BMP commonly implemented by Maine forest practitioners.

Riparian Area Analysis

A total of **67** sample units have a water body adjacent to the buffer/filter strip.

Sample Methodology

MFS field staff collected riparian data by randomly choosing one of the buffer areas within the sample unit. Latitude and longitude where recorded at the downstream end of the buffer feature being sampled. MFS staff then walked the length of the buffer / filter strip following the stream to its point of origin, the end of the sample unit, the end of the cutting area, a change in stream order or 1000 feet of length, whichever came first while measuring the length of the buffer.

Upon returning to the beginning of the buffer / filter strip, plots where established in the center of each quartile of the buffer filter strip length. The average of the four plots was recorded.

Evaluation

- Total length of buffer/filter strip monitored (feet): 39,307

Table 4

Sediment Delivery	
total number of locations where sediment delivered to within bankfull width of the channel as a result of harvest operation	19
number of locations per 1000 feet of buffer monitored	0.483
Sediment Volume (cubic feet)	
total volume of sediment currently evident within bankfull width of the channel resulting from harvest operations	115
volume per 1000 feet of buffer monitored	2.926
Rills, Gullies, Sediment Trails	
total number of times rills, gullies, or sediment trails resulting from the harvest operation reach more than halfway across the buffer/filter strip (specific delivery mechanism was not recorded)	14
Rills, gullies and sediment trails per 1000 feet of buffer monitored	0.356

Naturally Occurring Large Woody Debris (LWD)	
number of pieces of naturally occurring LWD in the water body	893
number of pieces LWD per 1000 feet of buffer monitored	22.719
Large Woody Debris (LWD) - Harvest Related	
number of pieces of LWD occurring in the water body as a result of the harvest	57
number of pieces of LWD per 1000 feet of buffer monitored	1.450
Potential Erosion Channel	
number of times a potential erosion channel has been gouged into the bank as a result of harvesting activities	17
number of times per 1000 feet of buffer monitored	0.432
Slash Volume (cubic feet)	
less than 100 cubic feet per 1000 feet of buffer monitored	0.840
100-200 cubic feet per 1000 feet of buffer monitored	0.153
more than 200 cubic feet per 1000 feet of buffer monitored	0.076

NOTE: Large woody debris is defined as debris found within bankfull width of the channel which are greater than 4 inches diameter at the small end and either longer than the stream width or anchored to the bank by roots or other means.

Slash is defined as limbs, brush, tree tops, or similar relatively small woody logging debris which is left in the channel below bankfull elevation as a direct result of the current harvest.

Shade Reduction/Basal Area Evaluation

Percent Crown Closure	
Average	80
Minimum	1
Maximum	100
Basal Area	
Average	82
Minimum	1
Maximum	212

Diameter of Largest Leave Tree	
Average	16
Median	15

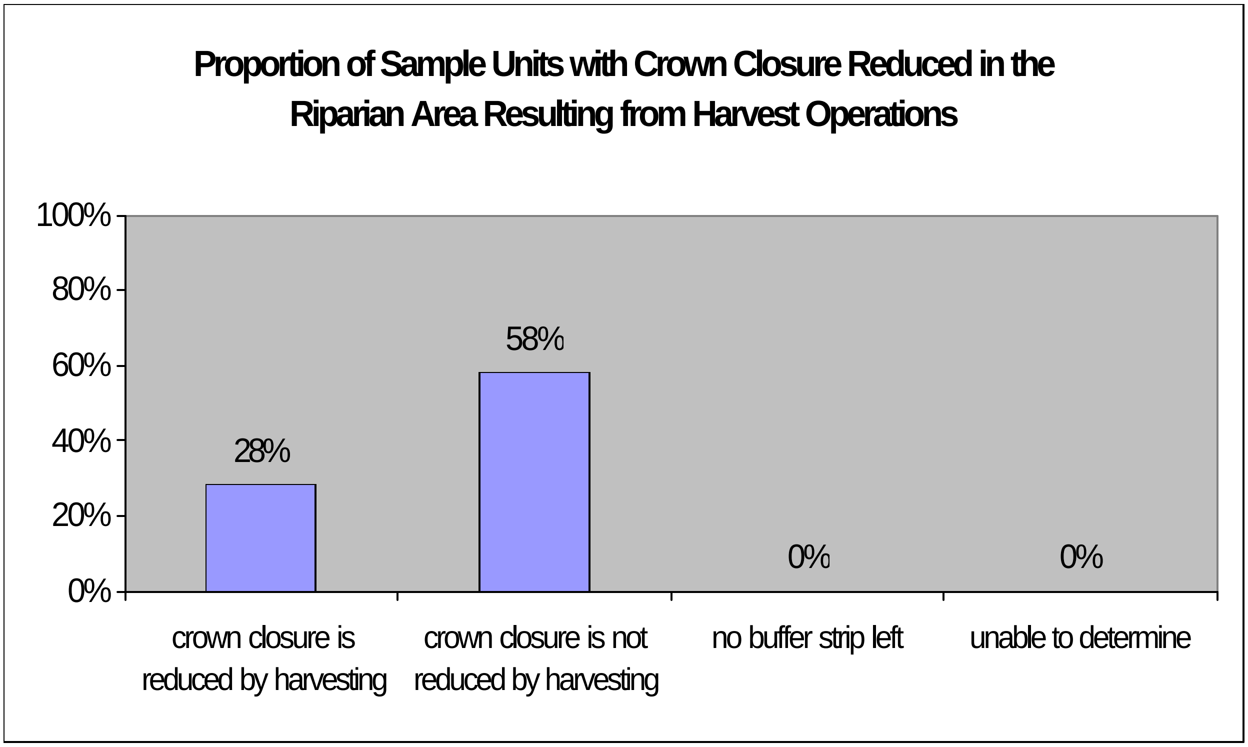


Figure 36 (n=67)

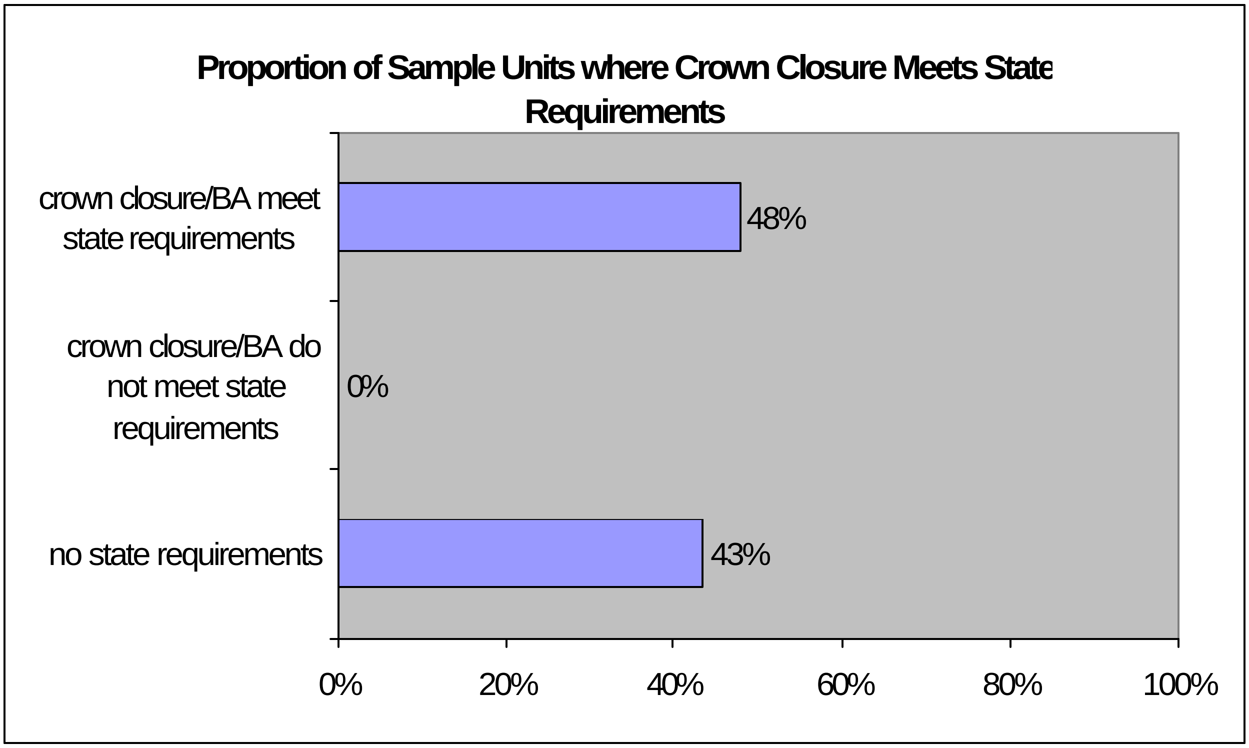


Figure 37 (n=67)

Discussion

DEP and LURC standards do not define shade retention (crown closure). Undefined shade applies below the 300 acre drainage point for LURC (unorganized areas) and at confluence of two first order streams for DEP (organized areas). Intermittent and first order steams typically make up over 80% of watercourses in any given New England watershed and are certainly the most prevalent type encountered in Maine's forests.

74% of the watercourses evaluated in the riparian area were of magnitude first order and smaller. 58% had no reduction in shade as result of the harvest. Average crown closure was 80% having an average residual basal area of 82 square feet per acre.

Data shows majority of harvests ***exceeded regulatory requirements*** by applying BMP recommendations that retained sufficient vegetation to maintain shaded conditions within riparian areas. Voluntary BMPs work!

Chemical Pollution Prevention

102 new sample units were sampled.

Evidence of Potential Pollutants

- **8** sample units had evidence of lubricant, fuel, hydraulic fluid and/or anti-freeze spillage resulting from harvest operations.
- **8** sample units had evidence of discarded batteries and/or other potential pollutant containers present.
- **4** sample units had evidence of both chemical spills, discarded batteries and/or other potential pollutant containers present.

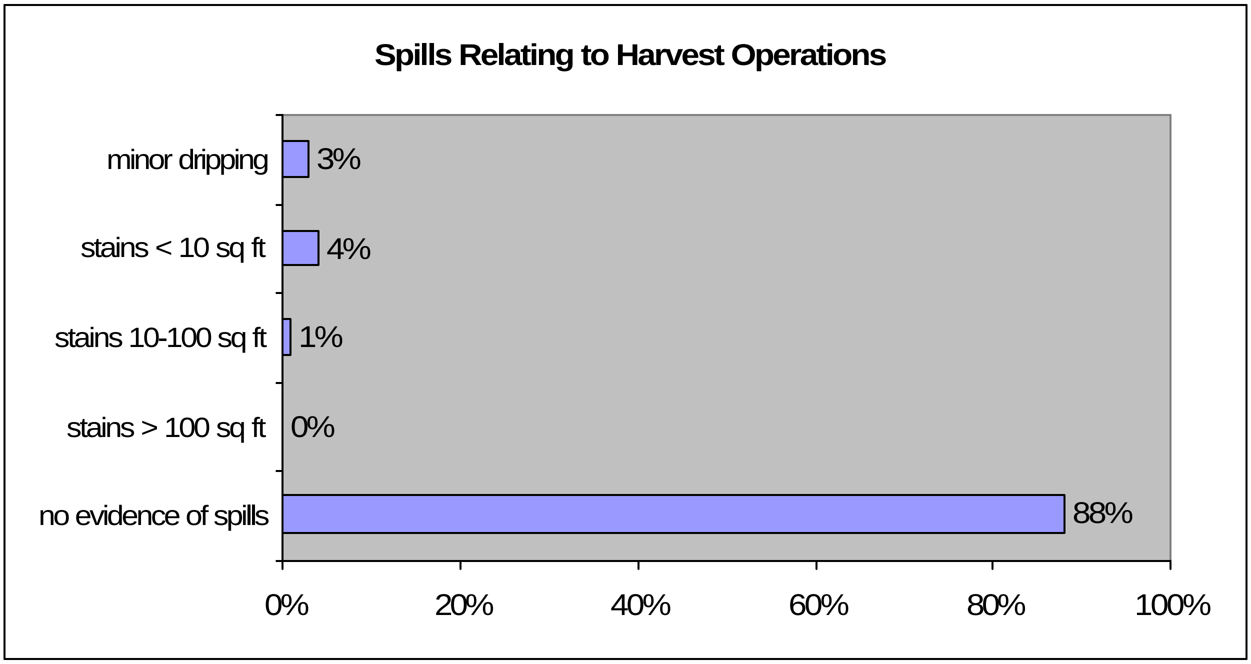


Figure 38 (n=102)

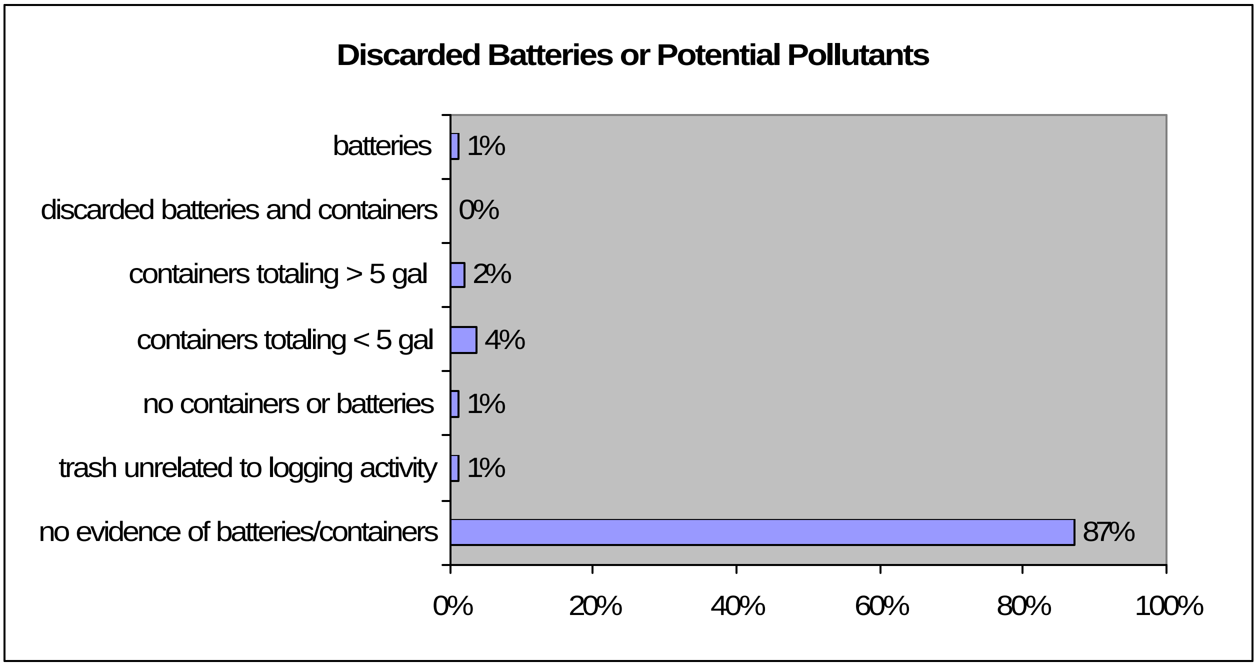


Figure 39 (n=102)

Soil Texture at Site of Evidence

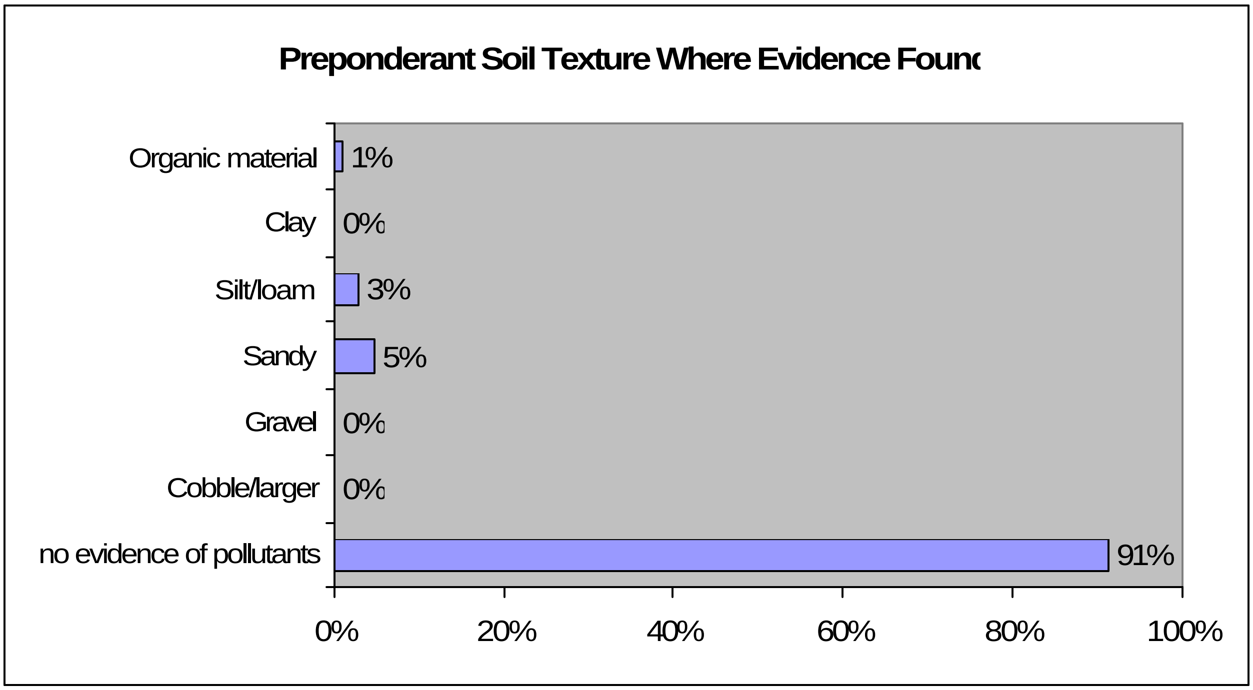


Figure 40 (n=102)

Evidence of Potential Pollutants Reaching a Water Body

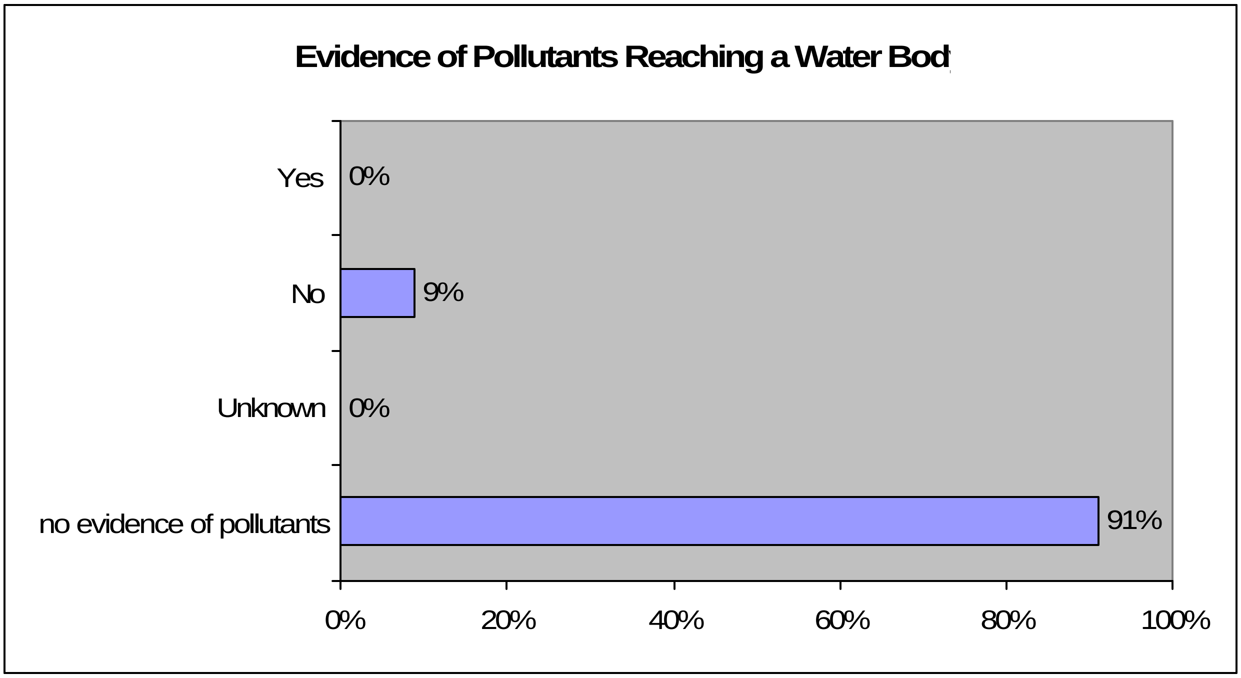


Figure 41 (n=102)

Discussion

Although no chemical pollutants made it to the waterbody, contamination remains a concern particularly in areas where groundwater may serve as private or public drinking water sources in near future. Forest practitioners should take great care handling and disposing fuel oil, ant-freeze, hydraulic fluid, and batteries. These common items are considered hazardous when not used and stored properly.

***BMP Principle**: Handle Hazardous Materials Safely*

BMP Practices

- Use appropriate containers for collecting and storing oils, fuels, coolants, or hazardous wastes
- Maintain and repair all equipment outside filter areas
- Have spill kits or other absorbent materials for mopping up spills readily available
- If a spill occurs keep it for flowing off the yard and into surface waters
- Know state agency phone to call in case of an emergency
- Collect trash and dispose of properly

Wetland Crossings

102 new sample units were sampled.

- **9** sample units have a wetland crossing.

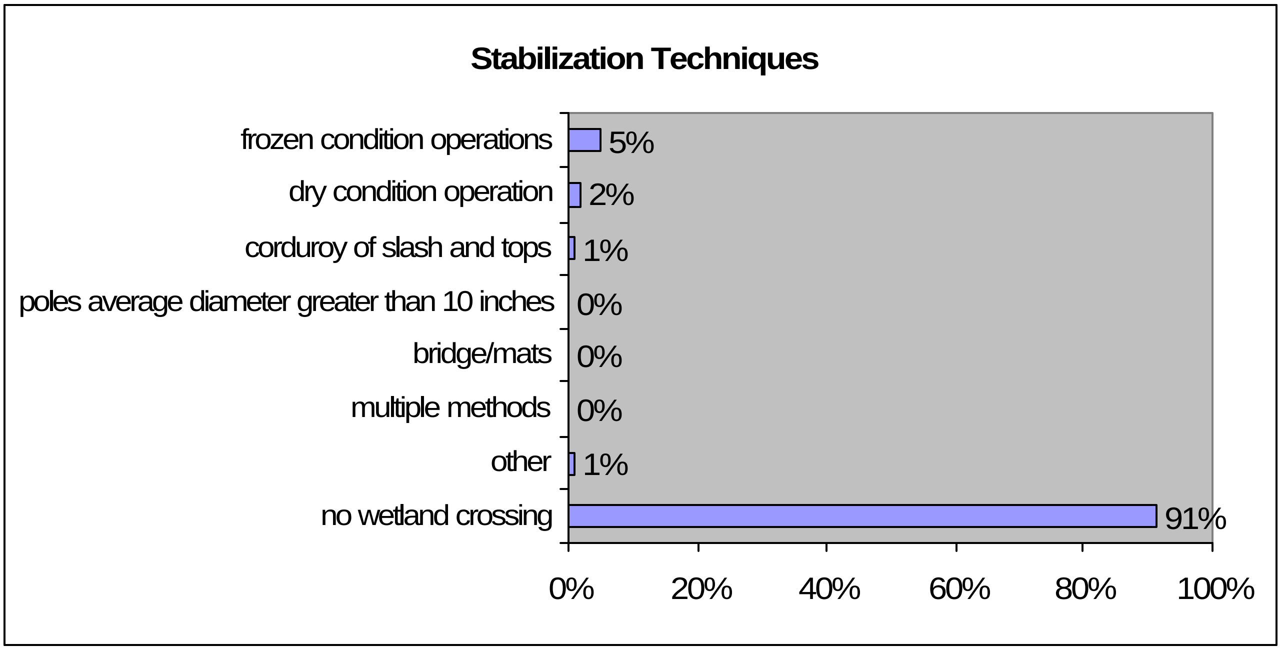


Figure 42 (n=102)

Wetland Crossing Length from Upland to Upland

	Length (feet)
Average	143
Median	110
Maximum	375

Table 5

Rutting Depth and Sedimentation

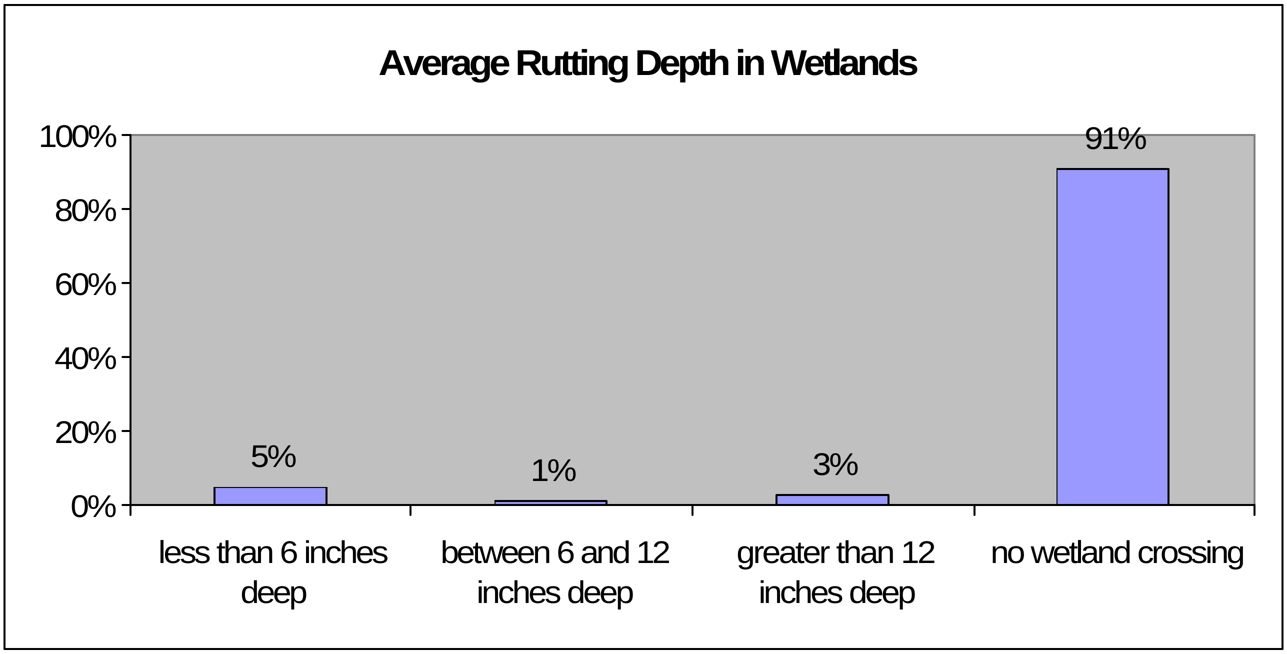


Figure 43 (n=102)

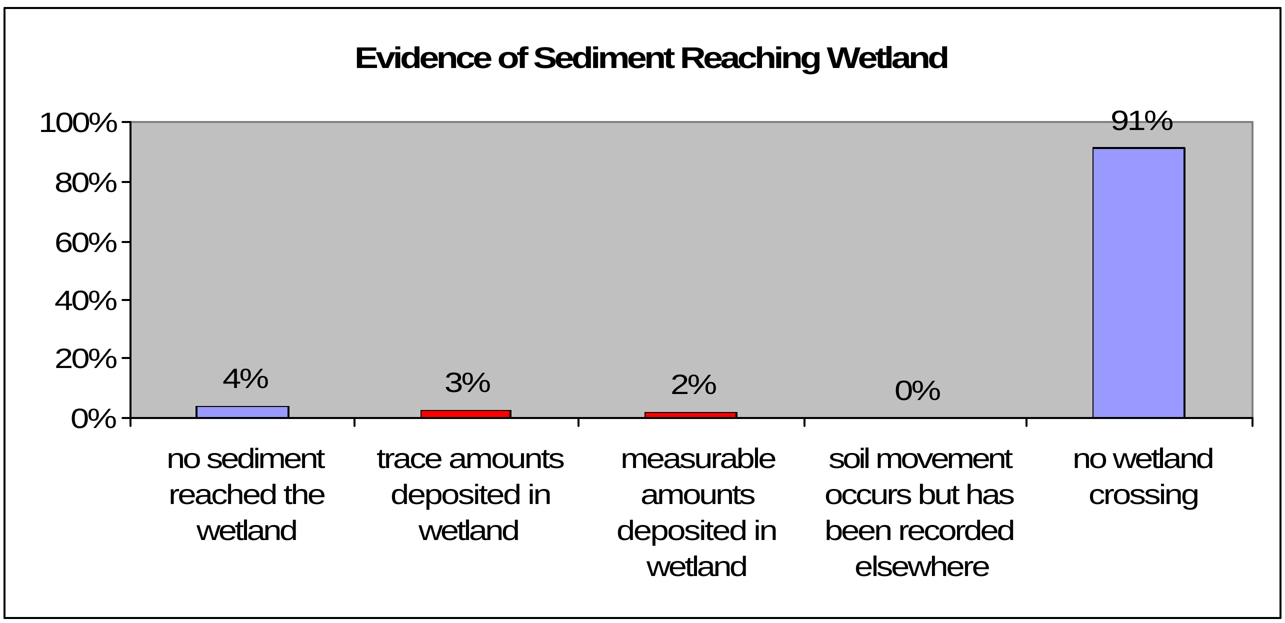


Figure 44 (n=102)

Discussion

Wetland crossings should be avoid whenever possible, with 91% of the samples having no wetland crossings it is evident that this BMP is commonly practiced in Maine. When wetlands do need to be crossed, adequate cross drainage must be installed so flow is not inhibited. Forest practitioners should seek additional technical assistance when having to cross wetlands.

Responsibility for BMP Implementation not Assigned:

Soil Conditions Observed at the Approaches

A total of 8 new sample units were sampled where no one was responsible by written contract for BMP Implementation.

4 of these sample units have a surface water crossing.

There are **four** opportunities to observe the occurrence of soil movement, soil sedimentation, or stabilization from the approaches to a surface water crossing. They are at Approach A outside the buffer, Approach A inside the buffer, Approach B inside the buffer, and Approach B outside the buffer. **Proportions are based on the total number of opportunities to make observations about soil conditions at the approaches.**

- For the **8** new sample units, there are **32** opportunities to observe soil conditions.

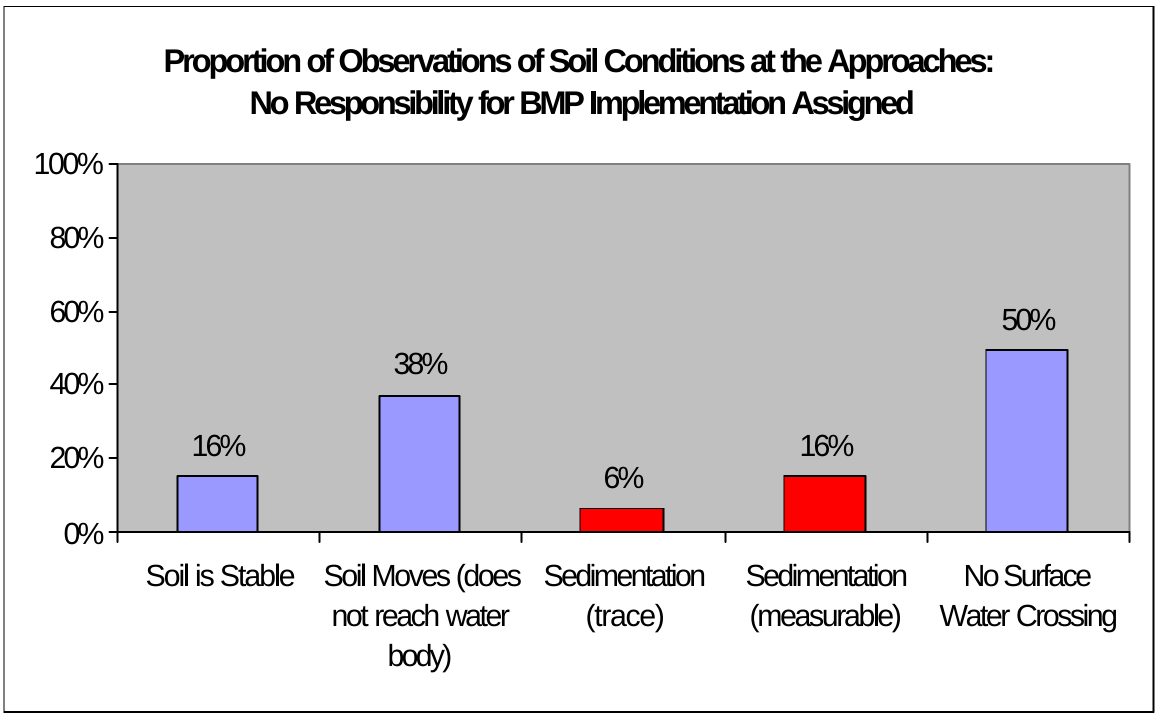


Figure 45 (n=32)

Sediment from the Approaches

There are **2** observations of trace amounts of sediment reaching the surface water body or deposited within bankfull channel width of the water feature.

There are **5** observations of measurable amounts of sediment reaching the surface water body or deposited within bankfull channel width of the water feature.

Forester Is Responsible by Written Contract for BMP Implementation:

Soil Conditions Observed at the Approaches

A total of **14** new sample units were sampled where a forester was responsible in by written contract for BMP Implementation.

- **7** of these sample units have a surface water crossing.

There are **four** opportunities to observe the occurrence of soil movement, soil sedimentation, or stabilization from the approaches to a surface water crossing. They are at Approach A outside the buffer, Approach A inside the buffer, Approach B inside the buffer, and Approach B outside the buffer. **Proportions are based on the total number of opportunities to make observations about soil conditions at the approaches.**

- For the **14** new sample units, there are **56** opportunities to observe soil conditions.

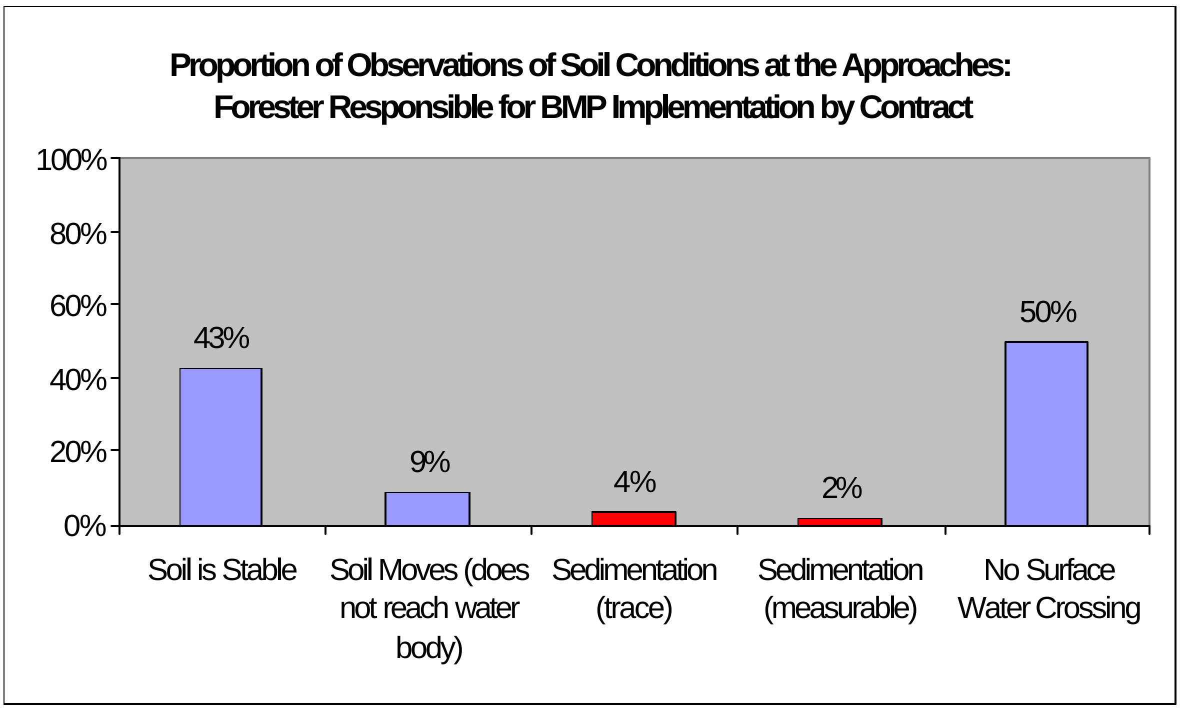


Figure 46 (n=56)

Sediment from the Approaches

There are **2** observations of trace amounts of sediment reaching the surface water body or deposited within bankfull channel width of the water feature.

There are **1** observations of measurable amounts of sediment reaching the surface water body or deposited within bankfull channel width of the water feature.

Logger Is Responsible by Written Contract for BMP Implementation:

Soil Conditions Observed at the Approaches

A total of **15** new sample units were sampled where a logger was responsible in by written contract for BMP Implementation.

- **9** of these sample units have a surface water crossing.

There are **four** opportunities to observe the occurrence of soil movement, soil sedimentation, or stabilization from the approaches to a surface water crossing. They are at Approach A outside the buffer, Approach A inside the buffer, Approach B inside the buffer, and Approach B outside the buffer. **Proportions are based on the total number of opportunities to make observations about soil conditions at the approaches.**

- For the **15** new sample units, there are **60** opportunities to observe soil conditions.

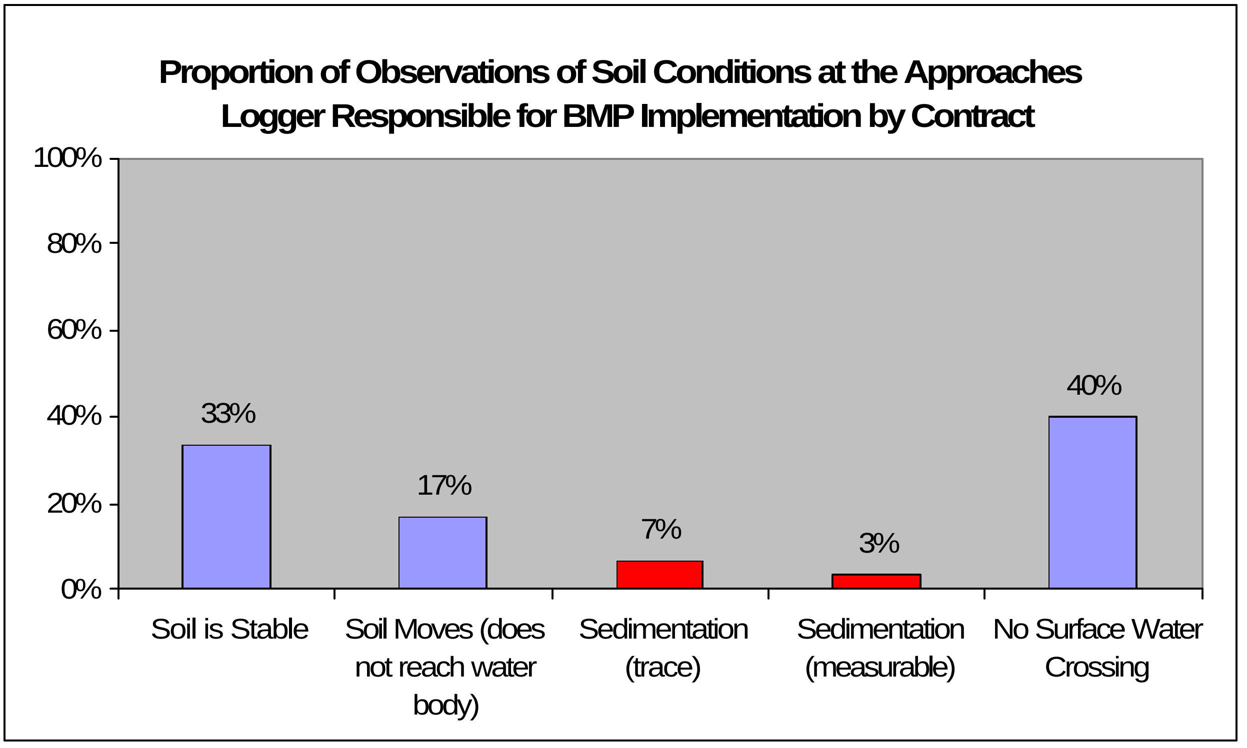


Figure 47 (n=60)

Sediment from the Approaches

There are **4** observations of trace amounts of sediment reaching the surface water body or deposited within bankfull channel width of the water feature.

There are **2** observations of measurable amounts of sediment reaching the surface water body or deposited within bankfull channel width of the water feature.

Table 6

BMP Assignment	Trace amount sediment reached water	Measurable amount sediment reached water
Not Assigned	6	16
Forester	4	2
Logger	7	3

Discussion

Harvests with written assignment for BMP implementation showed significantly less incidence of measurable soil reaching the waterbody. MFS encourages all timber harvest be accompanied by a written contract. Determining BMPs prior to the start of a timber harvest is an important element of pre-harvest planning. Undoubtedly, conditions will change; therefore it is important to adjust BMPs as needed. When questions arise, have contact information readily available to convey unanticipated site conditions.

Communication, written and verbal, is a BMP!

Appendix

Recent history of BMP monitoring in Maine

1996 - The Briggs & Cormier study reported on BMP use and effectiveness by examining recommended BMPs in detail on 120 harvest sites. The study concluded that applicable BMPs work well when implemented, but that use of individual BMPs varied from very low to very high. There was broad recognition of the need to provide regular, statewide information on trends in BMP use and effectiveness. Such information would help MFS to focus educational efforts for foresters, loggers, and landowners in BMP use.

The study also indicated site variables, changes in operational context, planning, maintenance, and proper closeout along with new erosion control techniques were not well addressed in the historic prescriptive context of BMP implementation. Clearly a new approach was needed.

1997 - The 118th Maine Legislature directs Maine Forest Service (MFS) to evaluate the progress made by timber harvesting operations in implementing forestry Best Management Practices (BMPs) to protect water quality (PL 1997, Chapter 648).

1998 - MFS, with the assistance of FORAT, develops a monitoring protocol to conduct regular statewide monitoring of BMP use and effectiveness on timber harvesting operations. The effort intends to increase efficiency over the Briggs methodology, establish long-term monitoring and at the same time focuses attention on activities and impacts more directly associated with water quality. Introduction to the **principles** of implementing BMP **practices** begins. MFS adopts a broader **outcome** based approach to evaluating BMP use and effectiveness by focusing on important issues (e.g. controlling soil disturbance), rather than individual **prescriptive** practices (e.g. use of waterbars). A concerted effort towards outcome based education and technical assistance for forest practitioners begins in partnership with Maine's Sustainable Forestry Initiative and others.

1999 - MFS field-tests a monitoring protocol and data sheet, making additional modifications upon review by FORAT, and trains MFS field staff in the use of the sheet. The methodology rates **BMP use** and BMP "**effectiveness**" (or impact to surface waters) independently. "BMP use" is evaluated relating to specific issues/areas of the harvest, based on a range of applicable BMPs. "Effectiveness" is more accurately an assessment of **impact** of harvest activities on water quality and is rated in terms of soil movement and soil delivery to surface waters. Sites are selected randomly statewide, based on Forest Operations Notifications (FON) submitted to MFS. Landowner permission to conduct the study is requested. The methodology does not assess compliance with state statutes, regulations, or local ordinances.

2000 - Regular, monthly monitoring of randomly selected field sites by MFS Field Foresters and Forest Rangers begins March, 2000.

2001 - Northeastern Area Association of State Foresters, Water Resources Committee initiates a project to develop, test and implement a standardized Best Management monitoring protocol. MFS leads development and testing 2001 through 2002.

2002 - MFS reports findings of initial monitoring of BMP use and effectiveness.

2003 - MFS completes of Phase 1 development of a regional protocol, which utilizes PDA's and palm pilot software for data collection. MFS Field foresters and Rangers continue to collect BMP data (2000 - 2003) via protocol monitoring sheets as part of routine BMP monitoring.

2004 - Regional BMP Protocol Study (Phase 2) partially funded through USDA Forest Service brings together NE area states for a larger regional study using MFS's 2003 BMP protocol with slight modifications. MFS begins limited beta testing. MFS rolls out new BMP manual: Best Management Practices for Forestry: Protecting Maine's Water Quality . In partnership with Maine's Sustainable Forestry Initiative and several Soil and Water Conservation Districts, MFS conducts over 50 BMP workshops which emphasize the outcome based approached to BMP implementation focusing on 7 fundamental BMP principles.

2005 - MFS provides training on revised Regional Protocol to MFS field foresters, distributes randomly selected sites to MFS District Foresters for 2005 field session.

2006 - MFS reports out for the first time using a Northeast Area Regional BMP Protocol utilizing standardized reporting format provided by USDA Forest Service.

Seven Fundamental BMP Principles

1. Define objectives and responsibilities
   - Determine the harvest objectives with the landowner, forester, and logger
   - Decide who is responsible for BMPs
   - Find out what legal requirements apply to waterbodies in the harvest area
2. Pre-harvest planning
   - Determine the harvest area limits and property boundaries on the ground
   - Identify waterbodies: streams, wetlands, ephemeral flows
   - Identify the areas where you need BMPs (identify material sources)
   - Layout harvest on the ground
   - Choose BMPs that are appropriate to the site conditions
   - Decide on BMPs for the entire harvest site area and for the closeout before beginning work
   - Consider the needs of future operations on the same property…different BMPs will apply
3. Anticipate site conditions
   - Time operations appropriately
   - Determine whether previous operations in the harvest area created conditions that are impacting - or could impact - water quality
   - Plan to monitor, maintain and adjust BMPs as needed
4. Control water flow
   - Understand how water flows in and around harvest area
   - Slow down runoff and spread it out
   - Protect the natural movement of water through wetlands
5. Minimize and stabilize exposed soil
   - Minimize disturbance of the forest floor, especially in filter area
   - Stabilize areas of exposed soil within filter areas and in other locations where runoff has the potential to reach filter areas
6. Protect integrity of waterbodies
   - Protect Stream channels and banks
   - Leave enough shoreline vegetation to maintain water quality
7. Handle hazardous materials safely
   - Be prepared for any emergency
   - Use and store hazardous material properly

Glossary

Bankfull Elevation	The point of demarcation between the stream channel and the floodplain. The bankfull elevation is at the elevation of the lowest depositional flat immediately adjacent to the channel and is often identified by the deposition of fine sands. These depositional flats are often discontinuous due to the shape of the valley.
Bankfull Width	The width of the channel from the bankfull elevation on one side of the channel to the bankfull elevation on the other side of the channel.
Best Management Practices (BMP's)	Defined by the Clean Water Act as practices used in forestry operations to minimize adverse impacts to the Nation's waters. See also BMP Practice
BMP Additions	Constructing additional BMP's on a given operation in response to problems developing after the initial installations
BMP Maintenance	Reshaping or reinforcing installed BMP's to compensate for wear from use or erosion or in anticipation of seasonal shutdown or extreme weather events. Such as seeding, reshaping waterbars or adding additional slash to reinforce skid trails or landing areas previously armored with slash.
BMP Practice	A wide range of techniques or procedures that, when used appropriately result in the greatest protection of the environment during the course of a logging operation. Examples of BMP practices include but are not limited to; waterbars, turnout ditches, soil stabilization, steam crossing avoidance, and communication.
BMP Principles	The fundamental laws of nature underlying the workings of BMP practices such as planning operations, controlling water flow, stabilizing soil, minimizing solar gain, and protecting and perpetuating natural habitats, etc.

Certified training program for loggers/contractors	Various programs intended to encourage safe and environmentally sound logging practices, including, but not limited to Master logger, CLP, QLP programs, or other recognized state, regional or national programs.
Crossing Structure Open Bottom	A bottomless crossing structure such as a bridge or an arch culvert which leaves the natural stream bottom intact and available to the stream biota.
Crossing Structure Closed Bottom	A crossing structure such as a culvert of metal, concrete, wood or other material which covers the natural stream bottom.
Culvert Embedded	A culvert installed with the bottom sufficiently below the natural stream bottom to allow the natural stream bottom material to become established continuously through the culvert.
Culvert Suspended	A culvert installed with one or both ends above the natural stream bottom.
Downcutting	See Scour Erosion
Land: industrial Forest	Land owned by individuals or businesses such as sawmills, paper companies, involved in processing logs and roundwood into primary forest products such as lumber and paper. Does not include secondary wood processors such as businesses purchasing lumber or paper from primary processors for further manufacture into item such as furniture or books.
Land: Non Industrial Private Forest	Land owned by private individuals or groups not directly associated with primary forest industries. Examples include investment groups, banks, sportsman's clubs, Appalachian Mountain Club, Trustees of Reservations, etc.)
Land: Public Forest	Land owned and managed by a town, county, state or federal government agency or entity.
Mechanical additions	Soil or fill material pushed into the stream channel by machinery in installing, removing crossing structures or regarding crossings or material from deep ruts that is pushed ahead of wheels, tracks or dragged logs.
Quality Control	Activities or data recorded for the purpose of assuring accuracy and consistency of the monitoring process.

Scour Erosion	Form of perennial stream channel erosion that occurs below the water surface. Usually caused by poor crossing structure alignment or the presence of obstructions such as sandbars, undersized culverts
Sedimentation: Deposit to a water body	Soil or fill material is considered to have entered the water body when it has been deposited within the bankfull width of the stream channel or below the normal high water level of lakes or within the boundaries of wetlands whether or not water is present at the time of sampling
Sedimentation: Measurable Amounts	A soil or fill material deposit which is observable below the bankfull elevation of the channel at the time of sampling, and attributable to the logging operation and when measured would round to 1 cubic foot or more. Examples include, but are not limited to deposits associated with a terminating rill or gully or a mechanical addition.
Sedimentation: Trace amounts	A soil or fill material deposit which is observable below the bankfull elevation of the channel at the time of sampling and attributable to the logging operation, but insufficient in volume to be readily measurable or if measured would round to less than 1 cubic foot. Examples include but are not limited to material in suspension, sediment film on vegetation, sediment traces or film on stream substrate.
Soil Movement:	Displacement or redistribution of soil by machinery or erosion processes such as slumping, piping, sheet flow and rill or gully erosion.
Soil Stabilization: Acceptable	Soils stabilization is acceptable when exposed mineral soil is protected from rain impact, sloped equal to or less than the natural angle of repose, armored, or vegetated and shows no evidence of rills, gullies, soil slumping or soil movement due to sheet flow with evidence of deposition, and is not associated with sediment delivery to a water body due to soil movement.
Stream Channel	A depression in the landscape formed and maintained by flowing water, sized to carry the normal flow and characterized by lack of vegetation and exposure of mineral soil, gravel and coarser materials or bedrock. And which is hydrologically connected to a higher order stream system. Stream channels do not include road ditch cross drainage culverts.

Water Flow Control: Acceptable	Situation in which water flow does not create rill or gully erosion, undercutting of slope or head walls of the water control practices, or blockage or breach of water flow control practices. And in which water is directed onto a stabilized area to allow filtering and /or infiltration prior to reaching a water body.
Weather: Extreme Events	Examples of extreme weather events include but are not limited to: 100 year storms, hurricanes, multiple rain storms with above average rain fall in a 24 hour period, or above average rain fall in a 24 hour period with high antecedent moisture content, rain on snow events or drought.